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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at $8.50 for the three-volume set.

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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **3802**

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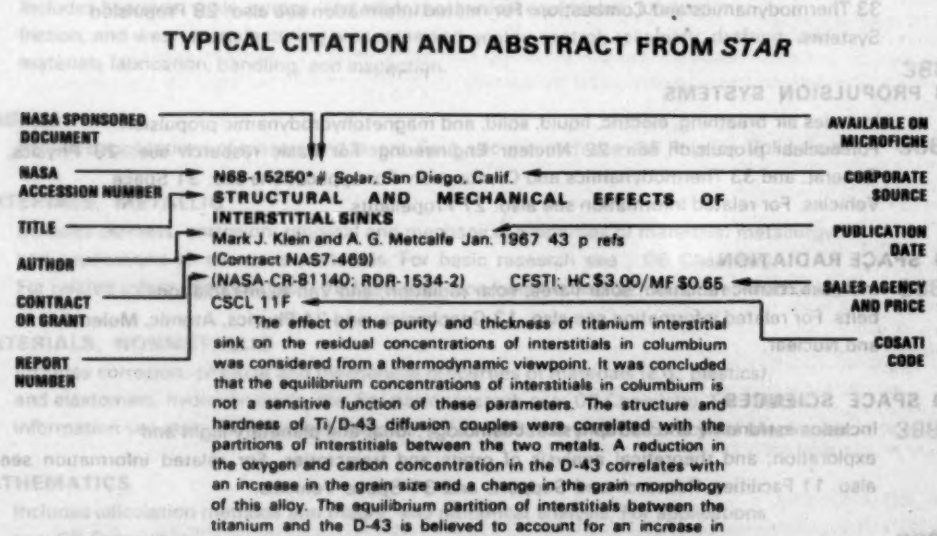
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N68-15250* # Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43.
Author

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

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N68-34916*# New York Univ., N. Y.
REPORT ON SONIC BOOM STUDIES: PART 2: INCIDENCE OF N-WAVES ON STRUCTURES
L. Ting and Y. S. Pan *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 89-98 refs (See N68-34907 22-02)
(Grant NGR-33-016-119)

A numerical program for the pressure distribution of an N-wave incident on a two-dimensional structure in the shape of a rectangular block is completed. For a three-dimensional structure, the averaging principle is employed to compute the intensification factors for corners and vertices for certain durations and to demonstrate the importance of the flight path direction. Author

N68-35019* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN IMPROVED PROGRAM FOR REDUCING FREE-FLIGHT DATA TO DERIVE AERODYNAMIC COEFFICIENTS FOR AXISYMMETRIC BODIES
Gerald N. Malcolm and Gary T. Chapman [1968] 62 p refs Presented at the 3rd AIAA Aerodyn. Testing Conf., San Francisco, 8–10 Apr. 1968
(NASA-TM-X-61223) CFSTI: $3.00 CSCL 01A

A large-scale Fortran IV computer program is described which improves and systematizes the data reduction procedures and eliminates all manual calculations. The system produces in one complete operation a set of quasilinear values for the aerodynamic coefficients of drag, lift, and static and dynamic stability. The quasilinear system is that linear system which best matches the actual flight behavior of the model tested. Improved procedures are used to calculate drag coefficients. The method of determining lift and stability coefficients was modified to reduce errors inherent in the equations of motion. Existing techniques are used for combining the quasilinear data for several flights at different amplitudes in order to obtain the nonlinear aerodynamic characteristics. The program is applicable to all types of free-flight data. Effectiveness of the data-reduction method was demonstrated in free-flight tests on the AGARD standard hypersonic ballistic correlation model HB-2. The results are compared with those of conventional wind-tunnels. Author

N68-35141*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF SEVERAL RAMP-FAIRING, UMBILICAL, AND PAD CONFIGURATIONS ON AERODYNAMIC HEATING TO APOLLO COMMAND MODULE AT MACH 8
James L. Hunt and Robert A. Jones Washington Sep. 1968 70 p refs
(NASA-TM-X-1640) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Test were made at angles of attack of 16°, 22°, and 28° and free-stream Reynolds numbers, based on model diameter, of 0.76×10^6 and 1.48×10^6. For the ramp-fairing–umbilical configurations tested, the area of high interference heating on the body at the windward base of the leeward umbilical was reduced substantially below that which occurred for the configuration having a protruding leeward shear pad and a flush-face umbilical; however, no significant reduction in the peak interference heating factor was observed. The presence of a simulated wire bundle case on the windward face of the protruding leeward umbilical appeared to reduce the peak heating on the body at the base of the umbilical. The highest heating rates on the Apollo configurations tested occurred in the interference regions of the shear and compression pads. The magnitude of these interference heating rates was 3 to 4.5 times the stagnation-point value for an angle of attack of 22° and a free-stream Reynolds number of 0.76×10^6 based on model diameter. The placement of a recessed umbilical just downstream of the leading edge on the windward afterbody produced interference heating factors of 1.26 and 1.48 just downstream of the umbilical for Reynolds numbers of 0.76×10^6, respectively. These heating factors were about 74 percent lower than the lowest peak factors obtained with any of the protruding leeward umbilical configurations. Author

N68-35173*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLOW-FIELD INVESTIGATIONS ON THE X-15 AIRPLANE AND MODEL UP TO HYPERSONIC SPEEDS
L. J. McLain and Murray Palitz Washington Sep. 1968 33 p refs
(NASA-TN-D-4813) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Flight measured impact pressures and local Mach numbers near the surface of the rear lower fuselage centerline, wing lower surface, and upper vertical tail of the X-15 airplane are presented and compared with calculated results and wind tunnel data. In addition, wind tunnel derived total pressures in the rear lower fuselage flow field are presented. The flight measurements are presented over a free stream Mach number range of 1 to 5.7 and an angle of attack range of 0° to 20°. The wind tunnel measurements cover a Mach number range of 4.0 to 8.0. The calculated predictions of Moeckel Love and Inouye Lomax at an angle of attack of 0° gave reasonable estimates of the flight measured flow field parameters in the three local flow regions. Flight measured impact pressures near the rear lower fuselage were somewhat lower than wind tunnel measurements, whereas the flight and wind tunnel measurements for the vertical tail and wing lower surface showed good agreement. Author

N68-35497*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT TRANSFER AND PRESSURE DISTRIBUTIONS ON SPHERICALLY BLUNTED 25° HALF-ANGLE CONE AT MACH 8 AND ANGLES OF ATTACK UP TO 90°

Dennis M. Bushnell, Robert A. Jones, and Jarrett K. Huffman Washington Oct. 1968 41 p refs
(NASA-TN-D-4792) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Local heat transfer and pressure distributions were measured over the conical portion of the cone. The investigation was conducted at at Mach number of 8.00 and Reynolds numbers of 0.37×10^6 and 1.65×10^6 based on free stream conditions and model base diameter. The pressure data are generally in good agreement with the semiempirical theory over the entire angle-of-attack range. The heat-transfer data for angles of attack up to 45° are in agreement with predictions using the small-cross-flow theory; whereas, the data at higher angles of attack are fairly well represented by the swept-cylinder theory based on the local cone diameter. Author

N68-35500# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Aerodynamik.
EXPERIMENTAL INVESTIGATIONS ON WAVE RIDERS (CARET WINGS) IN THE HYPERSONIC RANGE [EXPERIMENTELLE UNTERSUCHUNGEN AN WELLEN-REITER-FLUEGELN IM HYPERSCHALLBEREICH]
Klausdieter Kipke Jun. 1968 207 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-41; Rept.-67/39) CFSTI: HC $3.00/MF $0.65

A series of wave riders (caret wings) have been investigated in the hypersonic gun tunnel in the Mach number range from $Ma_{\infty} = 7.9$ to 15.5. The models investigated had the following parameters: The design Mach number varied between $Ma_{des} = 6$ and 10, the aspect ratio between $A = 0.8$ and 1.6, and the volume parameter between $\tau = 0.0675$ and 0.1. The tests included three component force measurements, pressure distribution measurements, and determination of the shock wave angle by flow visualization. Three-component force data were obtained by use of two strain gage balances, and the pressures were measured by four strain gage pressure transducers. The aerodynamic coefficients, c_L, c_D, c_M, and the pressure distributions have been compared with simple two dimensional wedge theory. A comparision between an extended Newtonian theory and a pressure distribution measurement shows good agreement. By use of differential interferometer photographs, the shock wave angle has been determined and compared with a simplified boundary layer calculation. At certain free stream conditions there are additional shock waves probably due to a transition of the boundary layer at the lower surface from laminar to turbulent. Author

N68-35523*# Fairchild Hiller Corp., Farmingdale, N. Y.
EFFECT ON BLUNTNESS ON HYPERSONIC TWO-DIMENSIONAL INLET TYPE FLOWS
Robert J. Sanator, John L. Boccio, and Dan Shamshins Washington NASA Oct. 1968 105 p refs
(Contract NAS7-416)
(NASA-CR-1145) CSCL 01A

Tests were performed on two geometric configurations—a flat plate and an isentropic compression ramp—each accommodating leading edges of three different radii. The nominal test Mach numbers were 7.3 and 10.55, with corresponding free-stream unit Reynolds number ranges of 0.25 to 2.0×10^6 per foot, and 0.75 to 2.0×10^6 per foot, respectively. Results generated during the test phases of this program are compared with theoretical analyses and reflect blunt leading edge effects on inviscid flow profiles, surface pressure phenomena and viscous layer growth along the models, with and without incident shock wave-boundary layer interactions. Author

N68-35617*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUBSONIC LONGITUDINAL AERODYNAMIC MEASUREMENTS ON A TRANSPORT MODEL IN TWO SLOTTED TUNNELS DIFFERING IN SIZE
Arvo A. Luoma, Richard J. Re, and Donald L. Loving Washington Oct. 1968 47 p refs
(NASA-TM-X-1660) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation of the static longitudinal aerodynamic characteristics of the same 5-foot-span (1.5-meter) model of a large subsonic cargo-type transport was made in the Langley 8-foot transonic pressure tunnel and in the Langley 16-foot transonic tunnel at Mach numbers from 0.700 to 0.825. The Reynolds numbers, the test conditions, and the data-reduction procedures were the same in the two investigations. The agreement in the data obtained was generally satisfactory. The greatest differences in the comparisons usually occurred at lift coefficients beyond the cruise lift where probably unequal effects of flow separation, particularly at supercritical speeds, may be expected. The results indicate that a model having a wing span which is large relative to the width of the test section can be tested in a slotted wind tunnel at subsonic speeds and that the results of such tests can be used with confidence provided the test techniques and data-reduction methods used adhere to acceptable standards developed for such tests. Author

N68-35665*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF SHAPE CHANGES ON THE AERODYNAMIC CHARACTERISTICS OF A TWISTED AND CAMBERED ARROW WING AT MACH NUMBER 2.03
Emma Jean Landrum and Barrett L. Shrout Washington Oct. 1968 22 p refs
(NASA-TN-D-4796) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The investigation was conducted in the Langley 4- by 4-foot supersonic pressure tunnel at a Reynolds number, based on wing mean geometric chord, of 4.4×10^6. The basic wing had a design lift coefficient of 0.08, a leading-edge sweep angle of 70°, and an aspect ratio of 2.24. The effects of shearing the inboard region, reducing the twist of the inboard region, and reflexing the aft portion of the wing were examined. When higher values of zero-lift pitching moment are required for a given wing the most promising modification of those examined was trailing-edge reflex. However, when extensive changes are permitted, a redesign of the entire camber surface would undoubtedly be the most desirable process. Author

N68-35668*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL BASE PRESSURES ON 9° SPHERICALLY BLUNTED CONES AT MACH NUMBERS FROM 10.5 TO 20
Charles G. Miller, III Washington Oct. 1968 43 p refs
(NASA-TN-D-4800) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Base pressure measurements were obtained at an angle of attack of 0° for a series of cones having semiapex angles of 9° and bluntness ratios of 0, 0.3, 0.55, and 0.8. Nominal free-stream Mach numbers were 10.6, 13.8, 15.6, and 19.6 and free-stream Reynolds numbers, based on model surface length, were approximately 0.02×10^6 to 2×10^6 in nitrogen. These conditions were assumed to result in laminar boundary-layer flow. Sting surface pressure distributions and sting tuft flow patterns were obtained 0 to 3.75 model base diameters downstream of the model base. The ratio of area-mean base pressure to stagnation pressure behind a normal shock for the spherically blunted cones was relatively insensitive to Reynolds number for Reynolds numbers greater than 0.1×10^6 but decreased with decreasing Reynolds number for Reynolds numbers less than 0.1×10^6 for all bluntness ratios. A semiempirical method for estimating the laminar base pressure ratio of spherically blunted cones in hypersonic flow for Reynolds numbers, based on model surface length, from 0.1×10^6 to 1×10^6 was found to yield reasonable agreement with the present measured base pressure results. The contribution of base drag to total inviscid drag decreased with increasing bluntness ratio and increasing Mach number. Author

N68-35672*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF A SIMULATED WING ON THE PRESSURE-DRAG COEFFICIENTS OF VARIOUS 15° BOATTAILS AT MACH NUMBERS FROM 0.56 TO 1.00
George D. Shrewsbury Washington Oct. 1968 34 p refs
(NASA-TM-X-1662) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A 10.16-centimeter-diameter-cylindrical-nacelle model was tested in the Lewis 8- by 6-foot supersonic wind tunnel with 15°-conical boattails having radii of curvature of 0-, 0.5-, and 1.0-nacelle diameters at their juncture with the nacelle. The conical nose of the nacelle was closed, and the jet was simulated with a cylindrical surface. The afterbodies were tested with the nozzle exit extended 0.866-, and 1.116-, and 1.366-nacelle diameters downstream of a small trapezoidal-wing trailing edge. Data were obtained over a Mach number range from 0.56 to 1.00 at angles of attack from 0° to 6°. Author

N68-35786*# Wyle Labs., Inc., Huntsville, Ala.
EXPERIMENTAL PROGRAM FOR THE INVESTIGATION OF TRANSONIC FLOW AROUND PROTUBERANCES IN THE AEDC-16T WIND TUNNEL FACILITY
J. E. Robertson May 1968 56 p refs
(Contract NAS8-21026)
(NASA-CR-61994; TM-68-6) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A testing program is proposed for investigating the steady and fluctuating airloads on the protuberance and surrounding structure of a transonic propulsion wind tunnel (16T). Specific and generalized protuberance geometries are included; and effects of Reynolds number, boundary layer thickness, and Mach number will be defined. Test facility and instrumentation are described; along with test conditions, which will include Mach numbers from 0.60 to 1.60 and a constant Reynolds number of 3×10^6 per foot. In addition to the computation of standard test condition parameters, on-line analysis will consist primarily of reducing mean flow parameters (static and total pressures) to descriptive terms. Boundary layer displacement thickness and momentum thickness will be computed at model station zero based on Bies' empirical relationships. Static pressure results stored on digital magnetic tape will be used to compute and plot contour and surface diagrams of mean flow pressure field around various protuberances. Computer programs for reducing stationary random data are discussed, including autocorrelation, spatial correlation, and probability density function aspects. M.W.R.

N68-35836*# Wyle Labs., Inc., Huntsville, Ala.
STATIC AND RELATIVE FLUCTUATING PRESSURE RESULTS OF A WIND TUNNEL INVESTIGATION OF SUBSONIC AND SUPERSONIC SEPARATED FLOW ABOUT CYLINDRICAL AND SATURN 5 MODEL PROTUBERANCES
S. Dendrinos, Jr. Jun. 1968 85 p refs
(Contract NAS8-21026)
(NASA-CR-61998; WR-68-13) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Shadowgraph, pressure, and flow visualization experiments were performed on a series of cylindrical and two scale model Saturn 5 protuberances in the 14- by 14-in. wind tunnel. The objective was to define the mean flow and acoustic environments around various protuberances, at both transonic and low supersonic Mach numbers. The results generally support earlier analysis of the flow. The flow region around the base of cylindrical protuberances was found to be three-dimensional. Upstream separation data was collapsed by the assumption that normalized height to the normalized diameter was proportional to the tangent of a characteristic separation shock wave angle, which varies with Mach number. Using this approach, it is possible to predict separation from Mach 1.96 to 5.0 for any protuberance in a crossflow. The magnitude of the overall acoustic environment in the protuberance wake was found to be 8 to 10 db relative to the undisturbed flow over the model at transonic speeds. Author

N68-35871# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PLOTTING QUASI-CONFORMAL REFLECTIONS FOR CERTAIN GAS DYNAMICS PROBLEMS [POSTROENIE KVAZIKONFORMNYKH OTOBRAZHENII DLYA NEKOTORYKH ZADACH GAZOVOI DINAMIKI]
G. S. Lipovoi 21 Sep. 1967 11 p refs Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 17, no. 1, 1965 p 112–117
(FTD-HT-67-402; AD-673763)

An analysis is given for the problem of quasi-conformal mapping of a region which represents the exterior of an airfoil onto the interior of the unit circle under the assumptions that the conformal mapping of this region is known and that the Mach number and circulation of the flow are given. The method developed by L. I. Sedov is used for constructing the transformation for quasi-conformal mapping. Author (TAB)

N68-35923# National Aeronautical Establishment, Ottawa (Ontario).
AN EXPERIMENTAL INVESTIGATION BY FORCE AND SURFACE PRESSURE MEASUREMENTS OF A WING IMMERSED IN A PROPELLER SLIPSTREAM. PART 1: FORCE AND MOMENT MEASUREMENTS
Y. Nishimura Natl. Res. Council of Can. Mar. 1968 74 p refs
(LR-501; NRC-10277) CFSTI: HC $3.00/MF $0.65

Three wing configurations were tested with various flap deflections and propeller thrust coefficients and through a range of wing incidences from 0° to 120°. The data reduction procedure has been chosen to permit isolation of the wing forces from the net forces on the complete model. The results of a comparison of the isolated propeller and propeller-wing tests indicate a slight increase in propeller thrust due to the presence of a wing in the slipstream. A simple theory is derived for relating the lift and drag characteristics of the wing in the presence of the propeller slipstream to those of the wing without slipstream. The calculated values agree well with the experimental observations. Author

N68-35965*# Northrop Corp., Huntsville, Ala.
EXPERIMENTAL DETERMINATION OF GENERALIZED VENTING CHARACTERISTICS
W. P. Walters, R. M. Glasgow, and J. M. Baker Jul. 1968 246 p refs
(Contract NAS8-20200)
(NASA-CR-61241; TR-792-8-368) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Results from an experimental study of gaseous air discharge from flat-plate orifices are presented. The data were obtained in a 6- by 6-foot supersonic wind tunnel. A Mach number range of 0.7 to 1.9 was used with a free-stream Reynolds number per foot of 1.5×10^6. Vent geometry, vent orientation, flat-plate boundary layer thickness, mass flow through the vent, and free-stream Mach number were varied in the tests. Based on (1) the free-stream static pressure; (2) the pressure on the lip of the orifice; and (3) the pressure in the orifice wake, three vent discharge coefficients were obtained for each configuration over the range of parameters studied. The boundary layer thickness over the plate, the static pressure distribution over the plate, and the downstream effect of the gaseous discharge from the vent (by three wake rakes) were also obtained. The test facility, the model and model installation, the wind tunnel test, and the data reduction are also described. Author

N68-35997# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Angewandte Gasdynamik.
ON MEASURING NOISE OF BODIES IN A FLOW IN SUBSONIC WIND TUNNELS, PART 1 [UEBER DIE GERAEUSCHMESSUNG AN UMSTROEMTEN KOERPERN IN UNTERSCHALLWINDKANAELEN, TEIL 1]

G. Schulz Jul. 1968 40 p refs In GERMAN; ENGLISH summary (DLR-FB-68-43) CFSTI: HC $3.00/MF $0.65

Problems in connection with noise studies of bodies in wind tunnel flow are discussed. The theoretical aspects of noise generation by the wind tunnel equipment are examined, and it is shown that presently available wind tunnels with normal equipment generate too much background noise to be practical for aeroacoustic studies. The analysis of a subsonic wind tunnel indicates that the blower is the greatest single noise source. Steps are suggested for improving the conditions for noise measurements on wind tunnel models. Transl. by K.W.

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-34907*# National Aeronautics and Space Administration, Washington, D. C.

SECOND CONFERENCE ON SONIC BOOM RESEARCH

Ira R. Schwartz ed. 1968 218 p refs Conf. held at Washington, D.C., 9–10 May 1968; Sponsored by NASA

(NASA-SP-180) CFSTI: HC $3.00/MF $0.65 CSCL 01A

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N68-34908*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ATMOSPHERIC EFFECTS ON THE SONIC BOOM

I. Edward Garrick *In its* 2nd Conf. on Sonic Boom Res. 1968 p 3–17 refs (See N68-34907 22-02)

Reviewed are studies relating to the atmospheric effects on sonic boom with emphasis on flight program results. The statistics of peak pressures follow approximately a long normal distribution, a result that is indicated by existing theory for pure (sinusoidal) sound. A tabular summary of the flight data gives the standard deviations of pressure peaks relative to calculated values of the mean. Observed variations of sonic boom signatures for different types and sizes of airplanes are included and the spectral content of some ideal and some measured pressure signatures is exhibited and discussed with reference to peakedness or roundedness of the wave. Author

N68-34909*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SONIC BOOM GROUND PRESSURE MEASUREMENTS FOR FLIGHTS AT ALTITUDES IN EXCESS OF 70,000 FEET AND AT MACH NUMBERS UP TO 3.0

Domenic J. Maglieri *In its* 2nd Conf. on Sonic Boom Res. 1968 p 19–27 refs (See N68-34907 22-02)

The paper reviews pertinent information obtained in recent years relating to atmospheric effects on the sonic boom and, in particular, includes some results of various flight programs. These atmospheric effects are complex, and a statistical approach appears necessary. The statistics of peak pressures follow approximately a log normal distribution, a result that is indicated by existing theory for pure (sinusoidal) sound. A tabular summary of the flight data gives the standard deviations of pressure peaks relative to nominal calculated values of the mean. Information is included on observed variations of sonic boom signatures for different types and sizes of airplanes. The spectral content of some ideal and some measured pressure signatures is exhibited and discussed with reference to peakedness or roundedness of the wave. Author

N68-34910*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LABORATORY SONIC BOOM RESEARCH AND PREDICTION TECHNIQUES

Harry W. Carlson *In its* 2nd Conf. on Sonic Boom Res. 1968 p 29–36 ref (See N68-34907 22-02)

Wind tunnel test data for a 6-inch long model of the XB-70 airplane are used to extend theoretical prediction methods for sonic boom signatures into the hypersonic speed range. An improved correlation of experiment and theory is found when the theory

accounts for an estimated 7.5° deflection of the elevon. Measured signatures for a ducted quadrupole device as a means of achieving sonic boom reductions indicate a significant difference at eight body lengths between the signatures measured below and to the side of the configuration. Difference in impulses seem to indicate that significant directional properties are produced by quadrupoles only when the pressure producing surfaces are displaced a greater distance from the body axis. It is concluded that benefits of quadrupole are slight when compared with simpler methods of lengthening the body. Recent laboratory studies on shock wave propagation are generally in agreement with predictions given by the laws of geometric acoustics. G.G.

N68-34911*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONFIGURATION DESIGN FOR SPECIFIED PRESSURE SIGNATURE CHARACTERISTICS
F. Edward McLean *In its* 2nd Conf. on Sonic Boom Res. 1968 p 37–45 refs (See N68-34907 22-02)

Near-field design concepts for the shape of a large airplane are used to obtain improved plateau pressure signatures and signatures with finite rise times in an effort to reduce sonic boom overpressures during supersonic transport flights. Theoretical design requirements for pressure signatures with finite rise time, such as the use of electrostatic effects or laser beams, and the problems associated with the practical attainment of these latter signatures is briefly outlined. G.G.

N68-34912*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EVALUATION OF CERTAIN MINIMUM BOOM CONCEPTS
Harry L. Runyan and Herbert R. Henderson *In its* 2nd Conf. on Sonic Boom Res. 1968 p 47–55 refs (See N68-34907 22-02)

The first part of this paper was concerned with an experiment and theoretical study of a rectangular configuration, and a study was made of the development of three-dimensional flow. In spite of the fact that the configuration physically did not resemble a body of revolution, as the theory assumes, relatively good correlation was obtained between theory and experiment at a distance of approximately only 1 body length. It emphasized the point that low-boom configurations based on two-dimensional reasoning may not perform according to expectancy, and that any configurations based on two-dimensional concepts must be studied in their real three-dimensional regime. The second part of the paper suggests the use of a sonic boom efficiency factor $L/D(\Delta p/p)_G$. Three planforms were examined by the use of this factor, and it was found that the arrow wing of very high aspect ratio was the best configuration, having low boom and high L/D, with the rectangular wing second and, surprisingly, the delta wing having the least efficiency from the sonic boom standpoint. Author

N68-34913# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CURRENT RESEARCH IN SONIC BOOM
Lynn W. Hunton *In its* 2nd Conf. on Sonic Boob Res. 1968 p 57–66 refs (See N68-34907 22-02)

Reviewed are flow field pressure prediction methods, effects of Mach number to 5.5 and boom minimization studies for supersonic aircrafts. A prediction method, using wind tunnel scale model measurements showed good correlation with actual flight overpressure data for the XB-70 except behind the tail shock. Effects of configuration geometry on maximum peak overpressures at Mach number 2,3,4, and 5.5 for three air breathing hydrogen-fueled hypersonic transports seem to indicate that a canard configuration gives the highest overpressured level that worsened with increased Mach number. Also included is a summary of overpressure characteristics measured on various shaped wings and a comparison with theoretical predictions. G.G.

N68-34914*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRELIMINARY INVESTIGATION OF FLOW FIELD ANALYSIS ON DIGITAL COMPUTERS WITH GRAPHIC DISPLAY
Harvard Lomax *In its* 2nd Conf. on Sonic Boom Res. 1968 p 67–71 (See N68-34907 22-02)

A digital computer system is being developed with the ability to compute flow fields about airplanes moving at supersonic speed with the aid of an immediately visual display of the calculations as they proceed. Preliminary studies indicate that differencing schemes for the hyperbolic partial differential equations governing discontinuous flow functions are valid when they approach spacings equivalent to the methods of characteristics. Artificially stabilizing methods based on continuous functions force the entire solution to decay. G. G.

N68-34915*# New York Univ., N. Y.
REPORT ON SONIC BOOM STUDIES: PART 1: ANALYSIS OF CONFIGURATIONS
Antonio Ferri and Ahmed Ismail *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 73–88 refs (See N68-34907 22-02)
(Grant NGR-33-016-119)

It appears that airplanes having lifting surfaces extended to the front of fuselage, and utilizing interference effects can be effective in reducing maximum sonic boom overpressure, because it utilizes near-field effects. Configurations have been investigated for supersonic transport which meet present SST design and requirement. It is shown that optimization on the waves of far-field analysis is not satisfactory. For a 300-foot airplane length, near-field effects can be obtained when sufficient lift is generated near the nose of the airplane. Because of near-field effects, sonic boom maximum overpressure on the order of 1 lb/ft^2 can be obtained with configurations that do not penalize the L/D of the airplane at cruise. Large improvements can be expected by limited increase of airplane dimensions. Author

N68-34917*# Cornell Univ., Ithaca, N. Y.
REDUCTION OF SONIC BOOM ATTRIBUTED TO LIFT
E. L. Resler, Jr. *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 99 106 refs (See N68-34907 22-02)
(Grant NGR-33-010-057; Contract AF 49(638)-1346)

The expected sonic boom associated with presently planned supersonic aircraft, particularly the commercial supersonic transports, is not likely to be received graciously by the general public. To alleviate this problem, ways to modify the aircraft's configuration to reduce or eliminate the sonic boom would be highly desirable. Physical arrangements to eliminate completely the boom attributed to lift are discussed in this paper. The particular configurations discussed derive their lift by imparting downward momentum to the fluid in the vicinity of the aircraft and canceling the far-field effects by other means, namely, a reduced area stream tube that could be accomplished by special engine designs. These principles are most easily demonstrated in the two-dimensional case and then extended to three-dimensional cases. Author

N68-34918*# Cornell Univ., Ithaca, N. Y.
THE APPROACH TO FAR-FIELD SONIC BOOM
F. K. Moore and L. F. Henderson *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 107–115 refs (See N68-34907 22-02)

A series is derived for small departures from an N-wave for bodies of smooth and discontinuous slope. For the latter, the leading terms suggest that adding a compression just ahead of the shoulder reduces shock strength in the approach to far field. A Euler transformation is found to improve convergence of the series. Author

N68-34919# Aeronautical Research Inst. of Sweden, Stockholm.
NONLINEAR EFFECTS ON SONIC BOOM INTENSITY
M. T. Landahl, I. L. Ryhming, and L. Hilding *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 117–124 refs (See N68-34907 22-02)

Matched asymptotic expansion methods are used to assess the importance of second order effects on the flow field pattern of high speed aerodynamics for a three-dimensional case. The associated change in shock strength is then calculated from the disturbance flow field by ordinary shock relations. G.G.

N68-34920# Colorado Univ., Boulder.
THE FEASIBILITY OF LARGE SONIC BOOM REDUCTIONS
Adolf Busemann *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 125–128 ref (See N68-34907 22-02)

The present abstract shows in detail only a small part of the feasibility study for large sonic boom reductions which is underway. The linearized theory was investigated with respect to the stratified atmosphere in the gravity field of the earth including the temperature differences for the cutoff at the sides and the changes of Mach number along the way. The next higher order terms, neglected in the linearized approach, were explicitly determined and investigated as to meaning. Lower altitude flight with positive control over the finite slope in all pressure rises replacing the common N-shape of the footprint has advantages, if the ear responds much less, and if the airplane can sustain droplets and ice crystals or is allowed to change altitude on bad days. Author

N68-34922# Cornell Univ., Ithaca, N. Y.
MULTIPOLES, WAVEFORMS, AND ATMOSPHERIC EFFECTS
A. R. George and A. R. Seebass *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 133–144 refs (See N68-34907 22-02)

The reduction of sonic boom by azimuthal redistribution of the pressure field about an an aircraft in supersonic flight was studied by analyzing the various multipole contributions to this pressure field. Considered were wave drag changes, lift, and off-axis positioning of various aircraft elements such as wing volume, pods, etc. Also evaluated was the effect of a steady, horizontally stratified atmosphere on the over pressure directly below the airplane. G.G.

N68-34923# Columbia Univ., New York.
UNIFORM RAY THEORY APPLIED TO SONIC BOOM PROBLEMS
M. B. Friedman and M. K. Myers *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 145–149 (See N68-34907 22-02)

A uniform ray expansion is used to predict finite values for the linear solution to the propagation of shock waves from a slender body of revolution moving at supersonic speed through a stratified medium in which the ambient sound speed is a monotonically decreasing function of the altitude. If the Whitham correction is applied to this linear field, shock strength decreases along the straight portion of the shock near the diffraction boundary and along the curved portion of the shock associated with the diffraction front. G.G.

N68-34924*# Aeronautical Research Associates of Princeton, Inc., N. J.
THE ARAP SONIC BOOM COMPUTER PROGRAM
Wallace D. Hayes (Princeton Univ.) and Rudolph C. Haefeli *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 151–158 refs Supported by NASA (See N68-34907 22-02)

Described is a computer program for calculating aircraft sonic boom signatures on the ground. The program computes ray tube areas correctly according to geometric acoustics, with both arbitrary maneuvers of the aircraft and arbitrary stratification taken into account. Calculated are sets of selected rays originating at the aircraft at particular flight times and with specified initial azimuth angles. Comparison of three sets of results for different maneuvers at Mach 1.2 show a sonic boom strength 1 to 2.5 percent larger with acceleration only, and about 1.3 to 3 percent larger in a shallow drive. G.G.

N68-35177*# Boeing Co., Morton, Pa. Vertol Div.
SUPPLEMENT TO FEASIBILITY OF V/STOL CONCEPTS FOR SHORT-HAUL TRANSPORT AIRCRAFT
Bernard L. Fry Washington NASA Sep. 1968 63 p refs
(Contract NAS2-3142)
(NASA-CR-743(1); D8-0375, V. 3) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Examination of the aircraft designed to the ground rules of the original study showed the considerable influence on aircraft size, and therefore cost, of such parameters as flight profile and fixed equipment assumptions. A revised set of ground rules was developed with respect to range, payload, reserves, flight profile, etc., and tilt wing and lift fan aircraft were designed to these ground rules. More economical aircraft than those designed to the original rules have resulted. One of the tradeoffs made in the original study investigated the effect of advanced propulsion technology. This report investigates the effect of advanced airframe and propulsion technology and shows that weight savings of more than 20 percent and direct operating cost (D.O.C.) reductions of 13 to 25 percent may be possible relative to 1970 aircraft designed to identical ground rules. Author

N68-35275# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
AN OPTIMAL CONTROL METHOD FOR PREDICTING CONTROL CHARACTERISTICS AND DISPLAY REQUIREMENTS OF MANNED-VEHICLE SYSTEMS Final Report, 1 Jul. 1966–31 Aug. 1967
Jerome I. Elkind, Peter L. Falb, David Kleinman, and William H. Levison Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Jun. 1968 173 p refs
(Contract AF 33(615)-5160)
(BBN-1559; AFFDL-TR-67-187; AD-672272)

An analytic procedure for determining information display requirements and human control and instrument monitoring characteristics for complex multivariable vehicular control systems is developed. The method is based upon the assumption that the human controller will act in a near optimal manner. Optimal control theory and its associated state-space representation is used as the basis for the analytic procedure. A model for the human controller is developed in which the controllers inherent limitations are approximated by a time delay. The model includes a predictor for compensating for this time delay, a controller for producing the control inputs to the vehicle and a cost functional that is to be minimimized. The controller is assumed to be optimal. Several suboptimal predictors are investigated. Only quadratic cost functionals are considered. The analytic procedure assumes that the human operators control characteristics can be represented by a set of gains operating on the delayed state variables of the system. These gains are predicted from the gains of optimal controller and from the characteristics of the predictor. It is further postulated that the information display requirements and instrument monitoring behavior can be determined from the sensitivity of the cost to changes in gain of the controller. Author (TAB)

N68-35304# Goodyear Aerospace Corp., Akron, Ohio.
MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR THE ASCENT AND DESCENT OF HIGH-ALTITUDE TETHERED BALLOONS, SCHEDULE SUB-LINE ITEM IAD Task Report Number 4
George R. Doyle, Jr. and Jerome J. Vorachek Feb. 1968 120 p refs
(Contract F19628-67-C-0145)
(GER-13714; AD-672735)

The results of the preliminary study indicate that it is feasible to launch and retrieve high-altitude balloons under certain conditions. It was shown that a 30 million cu ft balloon can be launched in a Summer I-75 percent wind profile at 2000 ft/min, and retrieved in the same wind at -200 ft/min with 20 percent of the helium valved off. Although launch and retrieval are possible in the Winter I wind profile, it is more restricted. The 79 million cu ft balloon

in the Winter I 25 percent wind show results similar to the 30 million cu ft balloon in the Summer I 75 percent wind. The results of the feasibility study can be used as preliminary design criteria for components of the tethered balloon-systems-balloon, tether and winch. Author (TAB)

N68-35305# Goodyear Aerospace Corp., Akron, Ohio.
HIGH ALTITUDE TETHERED BALLOON SYSTEMS STUDY. SCHEDULE SUB-LINE ITEM IAE Task Report Number 5
Jerome J. Vorachek 31 Mar. 1968 104 p refs
(Contract F19628-67-C-0145)
(GER-13790; AD-672736)

The present report presents tethered balloon systems configurations capable of supporting a 500 pound payload at an altitude of 100,000 feet in various wind conditions. Technical information compiled, generated and evaluated during the course of the program was used to define these tethered balloon system concepts. Insofar as possible, an attempt was made to take advantage of existing balloon technology, to evolve new concepts and to make judicious selections from previously defined concepts to define the tethered balloon system configuration recommended. A suggested plan for development of a system is presented. Author (TAB)

N68-35308*# National Aeronautics and Space Administration, Washington, D. C.
PROGRESS IN PILOT WARNING INDICATORS
Henry L. Anderton 26 Sep. 1968 9 p Presented at the 1968 Ann. Assembly Meeting of the Radio Tech. Comm. for Aeron., Washington, D. C., 26 Sep. 1968
(NASA-TM-X-61248) CFSTI: HC$3.00/MF$0.65 CSCL 01D

While no economically feasible technique currently exists for non-cooperative pilot warning, it is noted that efforts to devise such a system are underway and that several promising cooperative systems are reaching the flight testing stage. Even though the economic feasibility of cooperative systems has yet to be proved, their proper use would materially lower the risk of mid-air collisions. A speech dealing with pilot warning devices treats the problem of aircraft collisions in terms of the increasing use of general aviation aircraft and increasing air traffic control problems. M.W.R.

N68-35335# Bunker-Ramo Corp., Canoga Park, Calif.
ELAVATION OF FLIGHT DIRECTOR ELEMENTS-RISING RUNWAY, EXPANDED LOCALIZER, AND ROLLOUT STEERING-DURING SIMULATED CATEGORY3-C MANUAL AND SPLIT-AXIS LANDINGS Final Report
D. Vreuls, S. F. Barnebey, J. E. Brown, and D. E. Nichols Feb. 1968 100 p refs
(Contract FA67WA-1700)
(SRDS-RD-68-10; AD-672568)

A total of 19 commercial airline pilots flew a total of 684 ILS approaches through rollout without visual cues in a fixed base research simulation of a Boeing 707-720B (STIR). Results indicated that both longitudinal and lateral plane performance deteriorated when the expanded localizer operated. With the expanded localizer off, the rising runway improved full manual touchdown performance when it came into view at 200 feet of wheel height (47% successful). Pitch manual split-axis landings were best when the rising runway came into view at 100 feet (66% successful). Vertical plane manual performance was excellent through 50 feet of altitude, but the flare caused problems. Data are presented to show why the flare computation was not compatible with the human pilot, and the need for improved flare computation for human pilot use is discussed. Roll manual split-axis touchdowns were 73% successful; manual lateral control was not tight enough to consistently land the simulator on the runway. Autopilot roll axis control to touchdown was the major determinant of rollout success, following roll automatic touchdowns. The runway steering command slightly improved rollout performance whereas the expanded localizer had little effect. Pilots reportad that they would not attempt a category III landing without rollout steering command. TAB

N68-35373# Army Aeromedical Research Unit, Fort Rucker, Ala.
DEVELOPMENT OF A PAINT SCHEME FOR INCREASING HELICOPTER CONSPICUITY
James A. Bynum, Robert W. Bailey, John K. Crosley, and M. S. Nix, Jr. Sep. 1967 16 p refs
(USAARU-68-1; AD-673118)

Six paint designs were applied to top surfaces of helicopter rotors to assess value as an aid to conspicuity. Stimuli were presented to 40 aviators by the method of pair comparisons in actual flight tests and rankings were obtained. Data analysis indicated as first choice a scheme incorporating gloss white, fluorescent red-orange, and black. Author (TAB)

N68-35391# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
INVESTIGATION OF THE LATERAL/DIRECTIONAL STABILITY CHARACTERISTICS OF A FOUR PROPELLER TILT WING VTOL MODEL Final Research Report
Richmond P. Boyden and Howard C. Curtiss Apr. 1968 109 p refs
(Contract DA-44-177-AMC-8(T))
(Rept.-743; USAAVLABS-68-19; AD-673147)

Results of an experimental investigation to determine the lateral/directional stability characteristics of a four-propeller tilt-wing VTOL aircraft using a one-tenth scale dynamically similar model are presented. Test conditions include wing incidences of 89, 70, and 30 deg. Measurements of the transient motion of the model in the lateral/directional degrees of freedom and the static lateral/directional stability derivatives were made. The transient and steady-state data are analyzed assuming that the motions of the vehicle may be described by linearized equations, and the resulting static and dynamic derivatives are presented. The characteristics of the lateral/directional dynamic motion of the full-scale vehicle as predicted by the tests of the dynamically similar model are determined and discussed. All data are presented for a center-of-gravity position of 9-percent MAC, which is ahead of the most forward C.G. position of the aircraft (15-percent MAC), and the horizontal tail and flap programs differ from those presently used on the aircraft. Author (TAB)

N68-35416*# Techtran Corp., Glen Burnie, Md.
STATISTICAL INVESTIGATIONS OF THE OPERATIONAL LOADING OF THE LANDING GEAR OF A MAIN-LINE AIRCRAFT [STATISTICHESKIYE ISSLEDOVANIYA EKSPLUATATSIONNOY NAGRUZHENNOSTI SHASSI MAGISTRAL'NOGO SAMOLETA]
A. M. Pen'kov, M. P. Zhdanovich, and A. I. Radchenko Washington NASA Sep. 1968 11 p refs Transl. into ENGLISH from the Publ. "Samoletostroyeniye i Tekhnika Vozdushnogo Flota" Kharkov, State Univ. Press, 1967 p 52–60
(Contract NASw-1695)
(NASA-TT-F-11900) CFSTI: HC$3.00/MF$0.65 CSCL 01C

Statistical data characterizing the load spectrum on the landing gear of the AN-10 aircraft during various phases of a typical flight are analyzed. It is shown that up to 82% of all fatigue failures are caused by taxiing. Changes in aircraft weight within typical service conditions have practically no effect on the fatigue life. The loads acting on the landing gear differ for each individual concrete runway (and taxiway), and are highest for unpaved runways. An increase in taxiing speed from 25 to 50 km/hr on the same concrete surface leads to a 35% increase in fatigue damage to the landing gear, while a further increase in speed tends to decrease the fatigue load. Author

N68-35441# Goodyear Aerospace Corp., Akron, Ohio.
HIGH ALTITUDE TETHERED BALLOON SYSTEMS STUDY. SCHEDULE SUB-LINE ITEM 1AB
Jerome J. Vorachek 30 Nov. 1967 285 p refs *Its* Task Rept. No. 2
(Contract F19628-67-C-0145)
(GER-13552; AD-672737)

The report presents information which was compiled and generated for development of extremely high altitude tethered balloon systems. These data will be useful in establishing balloon systems and planning estimates. The report includes information on tether cables, balloon materials and balloon configurations. Results of analyses of superpressure natural shape balloons which are reefed as they ascend to and from float altitude are given. Aerodynamic coefficients for a natural shape balloon obtained in wind tunnel tests are also presented. An extensive set of cable and balloon parameter curves is provided for use in establishing multiple balloon systems with natural shape balloons, Class C balloons and Glastran E glass stranded cable. These curves provide cable and balloon data for intermediate altitudes between sea level, 50,000 feet and 100,000 feet. Workable cable-balloon combinations (neglecting ascent and descent conditions) for Summer I and Winter I wind conditions are defined as examples. Author (TAB)

N68-35557# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PULSE, SPECIAL AND SLIP MODES IN PROBLEMS OF FLIGHT DYNAMICS [IMPUL'SNYYE, OSOBYYE I SKOL'ZYASHCHIYE REZHIMY V ZADACHAKH DINAMIKI POLETA]
A. A. Bolonkin 29 Sep. 1967 28 p refs Transl. into ENGLISH from the publ. "An UKrSSR. Slozhnyye Sistemy Upravleniya" Kiev, Naukova Dumka, 1965 p 68–90
(FTD-MT-24-224-67; AD-672694)

The theory of pulsed, particular, and sliding modes of operation in optimal systems is applied to the study of the following flight dynamics problems: (1) optimization of trajectories of flight vehicles when the angle of attack and the direction of the thrust vector is controlled; (2) optimization of vertical take-off trajectories of an airplane; (3) controlling the thrust of a spacecraft during flight in a central field; (4) the problem of the maximum flight range of an airplane with a simultaneous optimization of the wing area. Under certain simplifying assumptions applied to the flight conditions, the equations of motion are written for all cases, the corresponding variational problems are formulated, and equations for determining extremals are derived. Analyses of pulsed, particular, and sliding modes of operation in the above-defined optimal were made which made it possible in many cases to simplify the solution of these problems. Author (TAB)

N68-35595*# Litchford Systems, Northport, N. Y.
ANALYSIS OF CUMULATIVE ERRORS ASSOCIATED WITH CATEGORY 2 AND 3 OPERATIONS WITH REQUIREMENTS FOR ADDITIONAL RESEARCH
G. B. Litchford Washington NASA Sep. 1968 29 p refs
(Contract NASw-1441)
(NASA-CR-1188) CFSTI: HC$3.00/MF$0.65 CSCL 01B

The results are presented of a study and investigation of conventional and unconventional terminal flight paths for CTOL aircraft in connection with low visibility landing problems. The interrelationships of the geometry of possible approach paths, visual and electronic guidance equipments, and numerous aircraft piloting problems are reviewed. Pilot display requirements for optimizing these interrelationships under typical airline operating conditions are described as well as the flight path dispersions expected at the transition from instrument to visual flight guidance. Areas requiring improved simulation, flight validation, or other means of establishing statistically significant data for these critical operations are identified. The ILS standards will be examined to identify errors that affect the transition from instrument to visual flight. Author

N68-35655*# Space Data Corp., Phoenix, Ariz.
SUPER LOKI DART METEOROLOGICAL ROCKET SYSTEM Final Report
Bruce Bollermann and Robert L. Walker 30 Jun. 1968 81 p
(Contract NAS8-20797)
(NASA-CR-61238) CFSTI: HC$3.00/MF$0.65 CSCL 16D

The Super Loki Dart meteorological rocket system was developed to obtain high-altitude (85 km) wind data with a low-cost rocket vehicle and a radar-reflective chaff payload. The Super Loki Dart consists of a scale-up of the older Loki Dart system which has been in use for many years to gather wind data to altitudes up to 65 km. The Super Loki Dart two-stage vehicle consists of a high-impulse solid-propellant rocket motor as the first stage, and a nonpropulsive dart which contains the chaff payload as the second stage. Altitudes as high as 125 km have been obtained with this vehicle system during the development flight tests at White Sands Missile Range. Altitudes to 113 km are expected for flights from sea level launch sites. A helical-rail launcher has been developed to impart spin or roll to the vehicle prior to release in order to minimize impact dispersion and associated range safety problems. The basic Super Loki rocket motor can be used to propel larger diameter instrumented dart systems to altitudes on the order of 85 km to upgrade the atmospheric temperature profile measurements currently being conducted by the standard-size Loki. Author

N68-35705# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
THE WALL JET BENEATH A COUNTER-FLOWING STREAM Final Technical Report, Sep. 1966–Mar. 1968
Paul E. Colin Mar. 1968 55 p refs
(Contract DAJA37-67-C-0045)
(AD-673200)

An experimental investigation of the flow arising from a wall jet beneath a counter-flowing stream was carried out. Such type of flow is related to the recirculation problem of jet lift VTOL aircraft flying or hovering in wind in ground proximity. Two different models were used in the program. The first one consisted of a circular cylinder with an elliptic nose shape whose axis was aligned to the main stream flow. An annular jet nozzle located at the rear of the model ejected air tangentially to the cylinder in the opposite direction to the main stream. The second model consisted of a flat plate with side walls. The jet nozzle was located along the trailing edge of the plate and the air was ejected tangetially to the surface of the plate toward the leading edge. The flow configuration obtained with both models showed a deep penetration of the jet in the main stream when the jet velocity was large compared to the free stream producing a large separation bubble with a strong vortex motion inside. Author (TAB)

N68-35734*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
LESSONS FROM THE XB-70 AS APPLIED TO THE SUPERSONIC TRANSPORT
Fitzhugh L. Fulton, Jr. [1968] 19 p Presented at the 21st Ann. Intern. Air Safety Seminar, Anaheim, Calif., 7–11 Oct. 1968
(NASA-TM-X-56014) CFSTI: HC$3.00/MF$0.65 CSCL 01C

Information obtained from the XB-70 test program which could be applicable to the supersonic transport is briefly reviewed. Problems are indicated involving inaccurate estimations of range, flight characteristics, and atmospheric conditions. The increased visibility due to the variable-position nose ramp is mentioned, along with the vertical-tape versus round-dial flight instrument display. Problems of constant altitude, overspeeds, and uneven inlet operation are described. Desirable and undesirable flying qualities are outlined, including deceleration and descent difficulties. Experience indicated that the landing gear should be simple and that modifications should be made to the hydraulic system. N.E.N.

N68-35744* Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
[RESEARCH DIRECTED TOWARD DETERMINATION OF ADVANCED AVIONICS TECHNOLOGY FOR A V/STOL AIRCRAFT PROGRAM] Final Report
Sep. 1968 169 p refs
(Contract NAS12-614)
(NASA-CR-86102; E-2338) CFSTI: $3.00 CSCL 01C

Background information and control system design data are presented in support of the Electronics Research Center's (ERC) program for advanced avionics technology for V/STOL aircraft. Linearized equations of motion are derived to form the mathematical model of the aircraft, and linearized performance functions are developed. For the helicopter simulation, all important stability derivatives are varied with airspeed, and provisions for generating trim conditions are made. Gross weight, c.g. position, and altitude are treated as constants during any given computer run. An alternate simulation scheme for generating trim values is described. Preliminary design details are given on the experimental equipment needed to permit in-flight evaluation of guidance and control systems in the YHC-1A helicopter. Schematic diagrams are included on the flight instrument—analog computer interface unit for the ERC fixed-base cockpit simulator. Selected parameters for several Boeing/VTOL helicopters are compared. A bibliography is included.
M.G.J.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-35123# Clevite Corp., Los Angeles, Calif.- Burgess Battery Div.
BATTERIES AND ELECTRICAL NOISE
John C. Geiger *In* Calif. Univ. Noise Reduction Conf. [1968] p 64–66 refs (See N68-35118 22-23)

Sources of electrical noise in multiple, single cell, and dry cell batteries are discussed. Also considered are sources of electrical noise in (1) some of the newer, more sophisticated batteries, such as water activated silver-chloride-magnesium types or those that carry their own electrolyte and are intended for high energy applications; and (2) nickel-cadium secondary batteries which are widely used. Emphasized are electrical noise conditions which arise under abnormal circumstances and which are due to faulty construction of cellular damage due to heat, cold, age, rough handling, or faulty equipment.
S.C.W.

N68-35139# California Univ., Livermore. Lawrence Radiation Lab.
ISOLATION IN POWERING SYSTEMS
Kris Aaland *In its* Noise Reduction Conf. [1968] p 239–250 refs (See N68-35118 22-23)

A powering system or, typically, a dc power supply is, by its very nature, an integrator or low pass filter to incoming power. Thus, power line transients and other high frequency power are converted to dc. A simple capacitor input rectifier arrangement is discussed. A narrowly conducting phase-angle supply of this type does, however, introduce harmonics to the line. For clean ac, the time-proven ultimate isolation scheme is to use M-G sets (rotating machinery). A competitor to this might be found in a new regulator/decoupler, the Parax.
Author

N68-35221# Army Electronics Labs., Fort Monmouth, N. J.
THERMOELECTRIC SILENT BATTERY CHARGER CHARGER
Joseph P. Angello Jun. 1968 20 p refs
(ECOM-2979; AD-673119)

The report describes the findings of electrical and physical characteristics and environmental effects on system performance of silent, multi-fueled, 10-ampere, 28-volt dc thermoelectric generators (PP-6074( )/U). The units run on gasoline, Diesel, JP-4, JP-5 and fuel oil, and are capable of generating 200 watt-hours of electrical energy for every pound of fuel consumed. Examples of Army field applications are presented which make use of the inherent qualities (silent, multi-fueled, lightweight and remote-start capability) of the power source.
Author (TAB)

N68-35232# Navy Space Systems Activity, Los Angeles, Calif.
SPACE POWER SUPPLY STUDY Final Report
Richard V. Silverman May 1968 178 p refs
(NSSA-R40-68-5; AD-672772)

This report presents the results of a parametric analysis, evaluation and comparison of space electrical power systems capable of meeting a set of mission requirements. The parameters include: continuous power (300 or 600 W), peak power (2, 3.5 or 5 kW), duty cycle (5%, 10% or 20%) and mission duration (1 to 12 months). The spacecraft is defined to be in a low circular polar orbit and the power systems are to be available in the 1970-1973 time frame. Six types of power systems (solar cell/battery, fuel cell, fuel cell/battery, solar cell/battery/fuel cell, solar cell/fuel cell, and radioisotope thermoelectric generators/battery) were evaluated for possible application to such missions. Evaluation and comparison criteria include mass, volume, procurement costs, reliability and spacecraft integration factors.
Author (TAB)

N68-35329# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AXIALLY SYMMETRIC LINEAR MAGNETOGASDYNAMIC FLOW WITH HALL EFFECT IN A TWO-COMPONENT MAGNETIC FIELD [OSESIMMETRICHNOE LINEINOE MAGITOGAZODINAMICHESKOE TECHENIE S EFFEKTOM KHOLLA V DVUKHKOMPONENTNOM MAGNITNOM POLE]
A. I. Bertinov, D. A. But, and S. A. Gorbatkov 15 Sep. 1967 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. Transport, no. 6, 1965 p 102–110
(FTD-MT-67-39; AD-673176)

These known magnetohydrodynamic-generator (MHDG) configurations are briefly examined: (1) Continuous-electrode channel, Faraday emf; (2) Sectionalized-electrode channel, loads fed with Faraday emfs; (3) Sectionalized-electrode channel, Hall emf; (4) Montardi scheme. The potentialities of these two combined configurations are considered: (5) A coaxial channel with a two-component magnetic field in which the emf is generated by both Faraday and Hall effects; no insulating wall is needed, and a small-size super-conducting magnetic system is applicable; (6) Same, but the electrodes are sectionalized as in (2). The latter two schemes are explored analytically. It is found that: (1) Scheme 5 with continuous electrodes obviates the difficulties connected with insulating walls and inserts in the channel; however, its specific (per unit volume) electric power is only 1/12 to 1/3 as high as that in other MHDG schemes; the specific power can be stepped up considerably if a higher temperature - and, therefore, higher gas conductivity - be used; (2) The characteristics of scheme 6 approach those of scheme 3; however, scheme 6 has no advantages stemming from the absence of insulating inserts; (3) The axial symmetry of the working flow and the applicability of simple torus superconducting magnetic systems are the two advantages of magnetohydrodynamic flows using the Hall effect and two-component field.
Author (TAB)

N68-35457# Naval Research Lab., Washington, D. C.
MICROPOROSITY IN LEAD–ANTIMONY GRID ALLOYS Interim Report
A. C. Simon Jun. 1968 22 p refs
(NRL-6723; AD-672889)

Microscopic examination of over two-thousand grid cross sections, which had been obtained from the product of many different manufacturers, indicated that grid microporosity was very high. Using magnification as low as 45X, microporosity was found in 20% of the grids by random sampling. Examination at higher magnification showed much more microporosity to be present, and it is estimated that 40 to 50% of the cross sections would have been found to be porous if examined at higher magnification

(800-1000X). Since the sampling was random, it is very probable that all of the cast grids had porosity at one or more points which could contribute to premature failure by corrosion. Author (TAB)

N68-35467*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THERMAL RADIATIVE AND ELECTRICAL PROPERTIES OF A CADMIUM SULFIDE SOLAR CELL AT LOW SOLAR INTENSITIES AND TEMPERATURES

John R. Jack and Ernie W. Spisz Washington Oct. 1968 18 p refs

(NASA-TN-D-4818) CFSTI: HC$3.00/MF$0.65 CSCL 10A

A typical thin film cadmium sulfide solar cell was investigated in a solar space environment simulator facility. The solar radiation intensity was varied from 0.028 to 1.07 solar constants. The associated solar cell temperature ranged from 155° to 325°K. The results showed that the absorptance–emittance ratio was approximately constant at 0.43 over the temperature range of 200° to 325°K. Below 200°K the absorptance–emittance ratio increased rapidly to 0.70 at a temperature of 155°K. Author

N68-35536*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF VARIABLE STATOR AREA ON PERFORMANCE OF A SINGLE-STAGE TURBINE SUITABLE FOR AIR COOLING. 3: TURBINE PERFORMANCE WITH 130-PERCENT DESIGN STATOR AREA

Harold J. Schum, Thomas P. Moffitt, and Frank P. Behning Washington Oct. 1968 24 p refs

(NASA-TM-X-1663) CFSTI: HC$3.00/MF$0.65 CSCL 21E

The performance changes resulting from adjusting the stator area of an experimental 30-inch (0.762-m) single stage turbine, with blading designed to incorporate physical features associated with turbines for high engine temperature application, are being investigated. The performance of the turbine with design stator area has been previously reported. The performance of this same turbine, modified so the stator area was increased to 130% of the design by reorienting the stagger angle of the blades, is presented herein. When results of these two turbine configurations were compared, it was found that when the stator area was increased by 30%, the choking equivalent work output of operating point corresponding to equivalent design speed and an equivalent work output of 17.00 Btu per pound (39.572 J/kg) showed that the efficiency decreased from 0.923 to 0.897 for the subject opened turbine. This decrease in efficiency is primarily attributable to the incidence angle relative to the motor, which was calculated to be changed about 28° from design. Author

N68-35666# Deutsche Versuchsanstalt fuer Luft- und Raumfahrt, Lampoldshausen (West Germany). Institut fuer Chemische Chemische Raketenantriebe.

EXPERIMENTS ON THE EFFICIENCY OF A BOILING WATER DRIVEN PELTON TURBINE [WIRKUNGSGRADUNTERSUCHUNGEN AN EINER HEISSWASSER-FREISTRAHLTURBINE] HEISSWASSER-FREISTRAHLTURBINE]

E. Ungerer Aug. 1968 38 p refs In GERMAN; ENGLISH summary

(DLR-MITT-68-18) CFSTI: HC$3.00/MF$0.65

The test stand of a boiling water driven Pelton turbine is described and the results of efficiency tests on a partially admitted Pelton turbine wheel are discussed. By theoretical considerations the superiority of an impulse turbine in comparison with a reaction turbine is demonstrated. In appendix the layout characteristics of a short time power plant of 100 MW with a Pelton turbine and a hot water accumulator are given. Author

N68-35752 National Lending Library for Science and Technology, Boston Spa (England).

THE FUTURE DEVELOPMENT OF ENERGETICS

L. Melent'ev [1968] 7 p Transl. into ENGLISH from Pravda (Moscow), 12 Jul. 1968

(M-7428) Available from Natl. Lending Library, Boston Spa, Engl.

As only an estimated 25% of the potential energy contained in various forms of fuel is actually used, the scientific and technical problems connected with developing and improving the efficiency of energetics are examined. The immediate concern is seen as strengthening the base of electrification primarily by improving existing methods of producing, transmitting, and exploiting electric power. It is estimated that by the 1980's the annual increase in electric capacity in the U.S.S.R. should approximate 30 to 35 million kw. Various channels which should be explored in producing electric power are assessed, with the prediction made that a leading role will be played by the use of nuclear fuel for producing electric and possibly thermal energy; the idea of combining atomic power stations and magnetic hydrodynamic generators is mentioned. Consideration is also given to the longer-term problems which are identified as the need to seek out new sources of energy; new methods of transforming thermal, nuclear, and chemical energy into electric power; and new ways of transmitting electricity over long distances. M.G.J.

N68-35814*# Texas Instruments, Inc., Dallas.

DEVELOPMENT AND FABRICATION OF LITHIUM-DIFFUSED SILICON COLAR CELLS Final Report, 18 Aug.–31 Jan. 1968

D. L. Kendall and R. A. Vineyard 31 Jan. 1968 46 p refs

(Contract NAS5-10274)

(NASA-CR-97077; TI-03-68-35) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The objective of this contract is to develop lithium-diffused P-on-N silicon solar cells of high conversion efficiency which display improved resistance to the effects of space radiation. The work is based on an observation of Wysocki that solar cells made with lithium-doped silicon demonstrated spontaneous annealing at room temperature after being damaged with high-energy electrons. The program involves the fabrication of experimental lots of silicon solar cells in which the basic parameters are varied, including base resistivity, crystal type, oxygen content, dislocation density, and lithium doping. Author

N68-35833# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.

INDUCTOR ALTERNATOR ROTOR FOR SPACE APPLICATION

Jack L. McCabria Aug. 1968 19 p refs Presented at the 3rd Ann. Intersoc. Energy Conversion Eng. Conf., Boulder

(Contract AT(04-3)-679)

(CONF-680802-3) CFSTI: HC$3.00/MF$0.65

The technology and design criteria for the rotor in a radial gap, potassium cooled, inductor alternator are discussed. Specific attention is given to the rotor material limitations, most favorable rotor speeds, and the reduction of pole face and windage power losses. Unique design considerations for the rotor cooling scheme are presented for alternator ratings between 0.4 and 12 MVA. Author (NSA)

N68-35839# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.

MAGNETIC FORCE UNBALANCE AND FLUX DISTRIBUTION IN INDUCTOR ALTERNATORS

C. C. Koube Aug. 1968 33 p Presented at the 3rd Ann. Intersoc. Energy Conversion Eng. Conf., Boulder

(Contract AT(04-3)-679)

(CONF-680802-2) CFSTI: HC$3.00/MF$0.65

The radial magnetic unbalance force acting on the rotor of a 467 kVA inductor alternator and the flux distribution within the alternator magnetic circuits under static (non-rotating) conditions are determined. The maximum rotor force was found to be a linear function of rotor eccentricity with a slope of 19,000 psi of rotor

eccentricity. A new procedure for calculating the ac flux in the armature core was formulated. Author (NSA)

N68-35888# General Electric Co., Owensboro, Ky. Tube Dept.
300 MILLIWATT X-BAND TRIODE OSCILLATOR Quarterly Report, 1 Jan.–31 Mar. 1968
J. M. Connelly and L. F. Jeffrey Aug. 1968 46 p
(Contract DA-28-043-AMC-01795(E))
(ECOM-01795-9; QR-9; AD-673720)

Thirty-three triodes were assembled. Of these, eighteen feature a grid design that has given best operational life to date, and eight had larger cathodes (0.130 in. diameter versus 0.120 in. diameter). Electronic tuning by means of the most recent diodes is inadequate in frequency range, unless inordinate rf energy is lost in the process. Smith charts of varactor diodes are presented to illustrate the problem. Author (TAB)

N68-35920# California Univ., Livermore. Lawrence Radiation Lab.
REGULATED MAGNETIC BURST GENERATOR
Kristian Aaland May 1968 20 p refs Presented at the 10th Modular Symp., New York, 21–22 May 1968
(Contract W-7405-eng-48)
(UCRL-71084; CONF-680520-2) CFSTI: HC $3.00/MF $0.65

A description is given of a 20-kW peak power pulse generator, used in a group of twenty generators supplying pulses to an array of instrumentation sensors at a combined pulse rate of 4MHz. Pulse requirements per generator are: bi-polar, 0.2 microsecond duration, triggered at rates up to 200 kHz, one-shot 30-millisecond burst, amplitude constant to 0.1% from pulse-to-pulse. A push-pull, switching core, 1:20 step-up transformer is driven from 150 V dc by high speed, high voltage, switching transistors operated in current-sharing parallel-connected groups. Negative feedback maintains constant current charging of a pulse forming network (PFN) on the secondary, during the approximately 3 microseconds to core saturation, after which the PFN discharges into a 50-ohm output cable, using the secondary winding saturated inductance as a portion of the PFN. Author (NSA)

N68-35947# Bright Star Industries, Clifton, N. J.
ORGANIC DEPOLARIZED CELLS UTILIZING METADINITRO-BENZENE Interim Report, 15 Oct. 1966–1 Oct. 1967
Sol S. Jaffe Ft. Monmouth, N. J. Army Electron. Command Jul. 1968 77 p
(Contract DA-28-043-AMC-01401(E))
(ECOM-01401-4; IR-4; AD-673825)

A report is given of progress in a program intended to develop and optimize techniques that are readily translatable to production methods for the fabrication of magnesium/magnesium perchlorate/m-dinitrobenzene dry cells in the R(N), A, and D sizes, and to test a quantity of cells so produced. Author (TAB)

N68-35948# Army Electronics Labs., Fort Monmouth, N. J.
PORTABLE MILITARY CHARGER FOR ZINC–SILVER OXIDE BATTERIES
Louis J. Pilla Jul. 1968 17 p refs
(ECOM-2988; AD-673717)

Battery Charger PP-4127A/U was designed to provide battery charger support for the Ground Surveillance Radar Set AN/PPS-5; the AN/PPS-5 is a portable battery operated system. The power source is a 6-volt, 60-Ah zinc-silver oxide battery. The battery charger provides compatibility between the battery and existing forward area engine generator sets. Proper charging of the zinc-silver oxide battery is a highly specific process. To maintain full charge capability and insure maximum cycle life, the battery must be charged with a controlled constant current at the 10-hour rate. When the battery reaches its end of charge voltage of 2.01 to 2.05 volts/cell, it is fully charged; the PP-4127A/U will then discontinue the charging cycle. The PP-4127A/U will charge two batteries simultaneously in a 10-hour period through the use of two seperate channels. It is portable, fully militarized and operational with 115/230 V, 50/60- and 400-Hz power sources. Its overall weight is 40.5 pounds and its efficiency is 53%. Author (TAB)

N68-35982# Gulf General Atomic, San Diego, Calif.
CESIUM SORPTION IN MATERIALS FOR THERMIONIC CONVERTERS
M. K. Yates and G. O. Fitzpatrick 8 Apr. 1968 54 p refs
(Contract AT(04-3)-167)
(GA-8574) CFSTI: HC $3.00/MF $0.65

Cesium sorption in materials which could serve as integral reservoirs in thermionic converters was investigated. Samples of integral reservoir materials were received and characterized as to their purity, BET surface area, and pore spectrum. Five samples from the carbon, graphite, porous tungsten, and porous alumina groups considered were selected and loaded with cesium over a range of 600° to 1000°C sample temperature, 0.1 to 30 torr cesium vapor pressure, and 0 to 1000 mg Cs/gram sample cesium loading. In addition, the cesium loadings of five porous tungsten samples were measured at 800°C and 10 torr cesium vapor pressure. The conclusions of these tests were that the cesium sorption in the Al_2O_3, tungsten, and carbon samples tested depended primarily on adsorption. Cesium loadings at 800°C and 10 torr were 0.4 mg Cs/g Al_2O_3, 0.06 mg Cs/g W, and 500 mg Cs/g carbon. The cesium loadings in these materials were in general agreement with their BET surface areas. The cesium loading in a W-10 wt % Te sample was 2.1 mg Cs/gm at 800°C and 10 torr. This loading was approximately 100 times that expected from surface area considerations, but these results were shown to be at least partly due to cesium sorption in the tantalum. The cesium sorption in the graphite samples tested depended primarily upon compound formation and was in general agreement with earlier work. At 800°C and 10 torr, cesium loadings of 400 mg Cs/gm were formed. The tests lasted from 100 to 1200 hours. At the conclusion of the testing it was discovered that the carbon sample had crumbled and that both graphite samples had delaminated. Author (NSA)

N68-36000*# TRW Systems, Redondo Beach, Calif.
STUDY TO ESTABLISH CRITERIA FOR A SOLAR CELL ARRAY FOR USE AS A PRIMARY POWER SOURCE FOR A LUNAR-BASED WATER ELECTROLYSIS SYSTEM, PHASE 1 Final Technical Report, 1 Jul. 1967–30 Jun. 1968
J. E. Boretz 30 Jun. 1968 549 p refs
(Contract NAS8-21189)
(NASA-CR-61979; TRW-09681-6002-R000) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Parametric performance and design data were developed to assess the feasibility of using large solar array systems on the lunar surface, and to determine the compatability of the solar arrays with the lunar environment. The candidate solar array configurations selected were the flat-skirted (shaded lunar surface), leanto-skirted, and oriented-skirted; the leanto- and oriented-skirted output power profiles were found to most closely match the load profiles for the baseline mission. Baseline mission requirements are established for setting up a lunar base for supporting lunar surface exploration activities. Trade-off studies were conducted between the lunar equipment prime electrical power system (LEPEPS) and the electrolytic reactants production system (ERPS) to arrive at the most cost-effective approach. It was concluded: (1) Both single crystal silicon cells and cadmium sulfide thin films provide adequate performance. (2) The solar array–fuel cell–ERPS system concept represents the most technologically advanced system that could be flight ready by the early 1970s. (3) The use of large solar arrays on the lunar surface is feasible; they can be made compatible with the environment by employing proper design techniques. M.G.J.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-34931*# Ohio State Univ. Research Foundation, Columbus.
CARDIOVASCULAR EFFECTS OF VIBRATION, PART 1
Final Report, 1 Jan.–31 Jul. 1968
Lester B. Roberts Aug. 1968 65 p refs
(Grant NGR-36-008-041)
(NASA-CR-98882, RF-5, Pt. 1) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The ECG was studied first to determine how clinically useful ECG tracings could be obtained from human subjects undergoing severe vibration. In order to evaluate equipment, procedures, and techniques, ECGs were obtained and averaged from six male volunteers while they were being vibrated Gz at vibration intensities from moderate to severe. The vibrations did not exceed one minute for moderate intensities or one-half minute for severe intensities. The study included the selection and modification of existing equipment, selection of adequate electrodes, development of optimum skin preparation techniques, and adaptation of signal-averaging techniques to the ECG signal. K.W.

N68-34940 Arizona Univ., Tucson.
COMPARISON OF THE STRUCTURE OF PROTEINS IN THE CRYSTALLINE AND SOLUTION STATE
Melvin Praissman (Ph.D. Thesis) 1967 197 p
Available from Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 67-16516

The structures of several proteins have recently been determined using crystallographic methods of analysis and have greatly increased our understanding of protein structure. However, it is the molecule in dilute solution that is generally of chemical and physiological importance and it is therefore necessary to assess the effect of crystallization upon protein conformation. Hydrogen exchange is a sensitive indicator of structure and a technique that can be used for the exploration of differences between the phases. The hydrogen exchange properties of insulin were examined over the pH range 2 to 10 and at several temperatures and ionic strengths. In solution, the hydrogen exchange of insulin was at a minimum near pH 3 and increased with increasing pH and temperature; exchange behavior characteristic of other proteins. Dissert. Abstr.

N68-35069*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES
Aug. 1968 154 p refs
(NASA-SP-7011(53)) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N68-35103*# Stanford Research Inst., Menlo Park, Calif.
RELATIVE ANNOYANCE AND LOUDNESS JUDGEMENTS OF VARIOUS SIMULATED SONIC BOOM WAVEFORMS
L. J. Shepherd and W. W. Sutherland Washington NASA Sep. 1968 59 p refs
(Contract NAS1-6193)
(NASA-CR-1192; LR-20922) CFSTI: HC $3.00/MF $0.65 CSCL 05E

A series of investigations were initiated in an effort to assess the effect of sonic boom signature modification on human subjective response, using Lockheed's sonic boom simulation facility. Subjective response was found to be influenced by changes in several signature parameter, including rise time, interpeak duration, and the addition of short duration transients to the signature bow wave. Detailed descriptions and the results of this series of experiments are described. Author

N68-35176 Indiana Univ., Bloomington.
A MODEL OF THE RESPONSE PATTERNS OF SINGLE CELLS IN THE MACAQUE LATERAL GENICULATE NUCLEUS
Israel Abramov (Ph.D. Thesis) 1967 128 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-15059

A quantitative model of these response functions is proposed. Spectrally opponent cells clearly receive inputs from at least two subsystems (excitatory and inhibitory) of different, but overlapping, spectral sensitivities, and the recorded responses represent some sort of difference between these inputs. Data were available from situations using chromatic adaptation to isolate the inputs from these subsystems. The action spectra of the isolated mechanisms appear to match the absorption spectra found for single primate cones, and the responses are described as linear functions of the log effective (absorbed) energy. It seems that the isolated inputs to LGN cells directly reflect cone responses. It is shown that each opponent cell receives inputs only from two of the three cone types. This is done by using stimuli which should be metamers, and elicit the same responses, if only two systems are involved, but not if there is any real contribution from a third system. Dissert. Abstr.

N68-35181# Joint Publications Research Service, Washington, D. C.
PROBLEMS IN SPACE TOXICOLOGY
V. V. Kustov 11 Sep. 1968 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), Jul.–Aug. 1968 p 605–608
(JPRS-46403) CFSTI: HC $3.00/MF $0.65

This article examines the problems in formulating the air environment in hermetically sealed rooms. It discusses findings on the liberation of toxic substances from various plastics into the cabin atmosphere and the principles and methods of medical-toxicological evaluation of polymer materials used in equipping the cabins of devices for space flight. An analysis is given of the literature on the hygienic significance of the products of human vital activity and feasible ways of setting the extreme tolerable limits thereof in the atmosphere of hermetically sealed cabins. Author

N68-35207# Naval Submarine Medical Center, Groton, Conn. Submarine Medical Research Lab.
THE CODE COPYING CAPABILITIES OF RADIOMEN UNDER SIMULATED ATMOSPHERIC NOISE CONDITIONS
Interim Report
Alan M. Richards May 1968 10 p refs
(SMRL-523; AD-672893)

The code-copying ability of Navy radiomen at various signal-to-noise (S/N) ratios under four conditions of simulated atmospheric noise, and under white noise, was tested. It was found that when a white noise was used, a critical S/N ration was reached where code copy deteriorated markedly. Prior to this point, code copy appeared to be undisturbed. When the simulated atmospherics were used, no appreciable deterioration in code copy

occurred at any of the S/N ratios sampled. It was pointed out, however, that equivalent S/N ratios for white and atmospheric noise are not necessarily the same. Therefore, qualifications must be made to a direct comparative analysis between simulated atmospherics and white noise maskers. It was further pointed out that if the S/N ratios for the atmospherics were lowered, some critical S/N might have been reached, as in the case of white noise, where code copy deteriorated rapidly. If this were the case, then a simple reduction of X decibels would be all that was necessary to generalize the obtained performance criteria obtained under white noise to atmospherics. Author (TAB)

N68-35212# Harvard School of Public Health, Boston, Mass. Guggenheim Center for Aerospace Health and Safety.
THE EFFECTS OF PHYSICAL AND SYMBOLIC STRESSORS ON PERCEPTIVE MECHANISMS Annual Progress Report, 1 Feb. 1967–31 Mar. 1968
Ross A. MacEarland, Warren H. Teichner, and Diane E. Olson 1 Jun. 1968 8 p
(Grant AF-AFOSR-1281-67)
(AFOSR-68-1516; AD-672275)

The research was concerned with the development of an approach to and methods for the prediction of human performance under conditions of environmental and informational stress. Emphasis was put upon attention and short-term memory in relation to temperature, noise and hypoxia, and to the development of attentional criteria of conditions which may be thought of as overstressing. This was done within a systematic context which relates physiological regulatory mechanisms to behavioral mechanisms. Author (TAB)

N68-35315# School of Aerospace Medicine, Brooks AFB, Tex.
A TECHNIC FOR PHOTOGRAPHING HUMAN RETINAL CIRCULATION DURING BLACKOUT ON THE USAFSAM HUMAN CENTRIFUGE
Voris A. Kirkland, Sidney D. Leverett, Jr., and William A. Newsom Mar. 1968 11 p ref
(SAM-TR-68-27; AD-672767)

To study the human retina on a moment-to-moment basis during the rapid sequence of events occurring before, during, and after a blackout episode on the human centrifuge requires a technic which will not harm the subject, yet will allow constant viewing. In a previous study an ophthalmoscope was used to study the retinal changes and then the subjective impressions of the investigator were recounted to a medical illustrator. A method has now been developed using a modified Zeiss fundus camera which allows photographs to be taken of the retinal circulation every 0.6 second during the entire +G maneuver at the subjects blackout level. Author (TAB)

N68-35382# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.
PULMONARY HYPERTENSION RESULTING FROM OXYGEN EXPOSURE
George H. Kydd 5 Jun. 1968 25 p refs
(NADC-MR-6802; AD-672755)

Rats exposed to an atmosphere of 95 to 100% oxygen at a partial pressure of 516 mm Hg for periods of 30 days showed no obvious abnormalities. At the end of this exposure they were removed from the system and anaesthetized. Aortic and intratracheal pressures were measured by standard direct procedures in response to breathing air and oxygen and to transient increases in intratracheal pressure. Compared with the results in unexposed rats, the experimental animals showed an increase in pulmonary arterial pressure (PAP) and a decrease in mean aortic pressure. The increase in aortic pressure caused by breathing oxygen which was present in the unexposed animals could be elicited in the exposed rats. The increase in PAP is attributed to structural changes in the pulmonary vasculature associated with oxygen exposure and it is postulated that an increase in vascular resistance is responsible for a decreased cardiac output, giving rise to the systemic hypotension. Whereas mean aortic pressure fell during increased intratracheal pressure, mean pressure from the right heart did not change, suggesting that the right ventricle empties itself less well against the increased pressure. Author (TAB)

N68-35388# Florida Presbyterian Coll., St. Petersburg. Primate Neuro-Sciences Lab.
THE EFFECT OF DIFFERENTIAL REARING ENVIRONMENTS ON SELECTED BODY ORGANS OF MACACA MULATTA Final Report, 6 Oct. 1967–15 Mar. 1968
W. F. Angermeier, John B. Phelps, and Herbert H. Reynolds Holloman AFB, N. Mex. ARL Jul. 1968 32 p refs
(Contract F29600-68-C-0007)
(ARL-TR-68-6; AD-672822)

Twenty-six male rheaus monkeys were sacrificed and organ pathology was completed, the following measures were taken: body weight, brain weight, thymus weight, adrenal weight, brain/body ratio, thymus/body ratio, adrenal/body ratio and gross and microscopic organ pathology. Differences between these measures based upon (1) early rearing experience and (2) shock-induced stress exposure were not significant. Intercorrelations between these measures were also computed. A number of them were found to be significant. Performance on a shock-escape match-to-sample task was found to correlate significantly with brain weight and brain/body ratio. Findings of this study do not agree with results of similar studies conducted on rats. Author (TAB)

N68-35393# Ohio State Univ., Columbus.
EFFECTS OF DISCRETE SKIN COOLING ON BODY TEMPERATURE AND SWEAT PRODUCTION DURING MODERATE HEAT STRESS Final Report, 1 Jan.–1 Jul. 1968
Thomas G. Byrne May 1968 72 p refs
(Contract AF 33(615)-2053)
(AMRL-TR-66-188; AD-673000)

Physiological responses to moderate heat stress were studied in a heat chamber for periods of 2 hours. Five conditions were established (two control series and three cooling series). Measured variables included heart rate, sweat produced, and rectal temperature. Thirty-eight experiments were done, involving eight subjects. The data were subjected to both conventional statistical analysis and computer techniques. Author (TAB)

N68-35434# School of Aerospace Medicine, Brooks AFB, Tex.
CHANGES IN PULMONARY VENTILATION, GAS METABOLISM, AND ENERGY EXPENDITURE DURING WEIGHTLESSNESS [IZMENENIE POKAZATELEI VNESHNEGO DYKHANIYA, GAZOOBMENA I ENERGOTRAT V USLOVIYAKH NEVESOMOSTI]
I. I. Kasyan, G. F. Makarov, and B. V. Blinov 1968 13 p refs Transl. into ENGLISH from Russian Presented at the 18th Congr. of Intern. Astronautical Federation, Belgrade, 25–30 Sep. 1967
(SAM-TT-R-942-0468; AD-672800)

The fact that gas metabolism and energy expenditure are more intense during weightlessness than during horizontal flight or G-loading leads to the conclusion that zero-G can greatly effect the human body. Cosmonaut energy expenditure in the space cabin or spacesuit will greatly exceed that recorded during brief zero-G or on earth. Thus, determining the energy expenditure required for various operations by the cosmonaut in space is of paramount significance. Author (TAB)

N68-35463# School of Aerospace Medicine, Brooks AFB, Tex.
SPACE PHYSIOLOGY [KOSMICHESKAYA FIZIOLOGIYA]
O. G. Gazenko, V. V. Parin, V. N. Chernigovskii, and V. I. Yasdovskii 1968 22 p refs Transl. into ENGLISH from Russian Presented at the 10th Congr. of the All Union Physiol. Soc. in Honor of I. P. Pavlov, Erevan, 22–28 Oct. 1964
(SAM-TT-R-733-0268; AD-672802

The goal of space physiology is to study the character and peculiarities of space flight stresses brought to bear on the organism of animals and man. The emphasis is on basic investigation--to seek out rational ways of increasing mans tolerance to space flight and to determine the basic, physiologic demands of a given organism on a spacecrafts environment and equipment complex. It is in this light that conditions amenable to optimal crew performance must be sought. The influence on the body of three basic groups of factors is discussed: (1) Those associated with the dynamics of spece flight (acceleration, weightlessness, vibration, etc.); (2) Those associated with long missions in the artificial environment of a space capsule (microclimate, isolation, hypodynamia, etc.); and (3) Those which characterize outer spece as a unique environment of habitation (radiation, temperature or thermal conditions, etc.). Author (TAB)

N68-35465# School of Aerospace Medicine, Brooks AFB, Tex.
PROGRAMMED PHYSIOLOGICAL MEASUREMENTS AND THEIR USE DURING VOSKHOD SPACE MISSIONS [METODIKA PROGRAMMIROVANNYKH FIZIOLOGICHESKIKH IZMERENII I OPYTEE PRIMENENIYA NA KOSMICHESKOM KORABLE VOSKHOD]
R. M. Baevskii and D. G. Maksimov 1968 27 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 4, no. 5, 1966
(SAM-TT-R-946-0468; AD-672801)

Experiments were performed involving the use of programmed physiological research on the Voskhod spacecraft. Using but one radiotelemetry channel to record three, single-phase tests requiring a total of ten minutes, a great volume of data and new facts of interest concerning the impact of zero gravity on the various organic systems were obtained. The Voskhod space mission pointed out the feasibility of conducting medical research along the lines of a specific program performed by the cosmonauts themselves, the expediance of using the removable sensors and electrodes, and the feasibility of relaying a great quantity of data utilizing a limited number of telemetry channels. At the same time, the experiment indicated the proficiency of cosmonauts in executing specific tasks. Author (TAB)

N68-35507# National Academy of Sciences—National Research Council, Washington, D. C. Committee on Hearing Bioacoustics Biomechanics.
PROPOSED DAMAGE-RISK CRITERION FOR IMPULSE NOISE (GUNFIRE)
W. Dixon Ward Jul. 1968 13 p refs
(Contract Nonr-2300(05))
(AD-673223)

Contents: Proposed criteria (definitions, basic criterion, and correction factors); Explanation and justification; and Limitations. TAB

N68-35567# Deutsche Versuchsanstalt Fur Luft- und Raumfahrt, Bad Godesberg (West Germany). Inst. Fuer Flugmedizin.
THE MODIFICATION OF THE CIRCADIAN RHYTHM BY AGE AND SEX IN HUMANS [ZUR MODIFIZIERUNG DER MENSCHLICHEN 24-STUNDENRHYTHMIK DURCH ALTER UND GESCHLECHT]
Ruediger Finger Jun. 1968 69 p refs In GERMAN; ENGLISH summary
(DVL-783; DLR-FB-68-31) CFSTI: HC$3.00/MF$0.65

The oral temperature, vital capacity, optical reaction time, and circulatory function according to the Schneider test were measured every three hours in three different groups to evaluate the effects of age and sex on the circadian rhythm. Average age and sex of the groups were as follows: female and 23, male and 26, and male and 47. Except for the expected differences in the mean values, the temporal position of the positive and negative extreme values differed between the groups for blood pressure, vital capacity, and reaction time. Most of the variables showed group differences in the range of oscillation, the biggest difference appearing in oral temperature between males (0.7° C) and females (0.4° C). When the oscillation ranges of all the measured parameters were averaged, the oscillation ranges of the older males and the females were similar, and both were smaller than the one of the younger males. The correlation between mean values and oscillation ranges was mostly positive, except for some variables in the female group and the Schneider index in all groups. Author

N68-35607*# Naval Aerospace Medical Inst., Pensacola, Fla.
EVALUATION OF SIXTEEN ANTIMOTION SICKNESS DRUGS UNDER CONTROLLED LABORATORY CONDITIONS
Charles D. Wood and Ashton Graybiel 7 Aug. 1968 11 p refs
(NASA Order R-93)
(NASA-CR-97039, NAM1-983) CFSTI: HC $3.00/MF $0.65 CSCL 06O

The effectiveness of a drug in reducing susceptibility to acute motion sickness is readily determined in a slow rotation room (SRR) where the stressful Coriolis accelerations are under quantitative control and the experimenter and subject can collaborate under laboratory conditions. Fifty subjects were used, each serving as his own control, in evaluating 16 representative antimotion sickness drugs. Only the drugs with a sympathomimetic or parasympatholytic action and some of the antihistamines were notably effective. The summation effect of dextroamphetamine sulfate and l-scopolamine hydrobromide provided far better protection than any single drug. Other classes of drugs had either a slightly favorable or slightly unfavorable action. Author

N68-35658# Massachusetts General Hospital, Boston.
IMMEDIATE STIMULATING PROPERTIES OF X-RAYS Progress Report, 1 May 1967–30 Apr. 1968
John Garcia 30 Apr. 1968 27 p refs
(Contract AT(30-1)-3698)
(NYO-3698-1) CFSTI: HC$3.00/MF$0.65

Studies were conducted on sensory perception of X-rays by rats. The problem as to whether the stimulating influence is exerted directly on the olfactory receptors or by way of airborne products is of particular interest. Rats are being trained to discriminate between flickering and steady state exposure to X-rays The effects of X radiation on the frog heart were studied, and it was found that the rate of beating decreased. Experiments with atropine indicated that the radiation caused the release of acetylcholine from synaptic endings of the vagus nerve. In vivo and in vitro preparations of guinea pig intestine (ilium) showed increased tone after the onset of X radiation. Similar changes were seen in uterine preparations. Effects of serum from γ-irradiated rats caused marked increase in tone of the ilium in vitro. Radioinduced aversions to water flavored with hydrochloric acid or quinine were produced in rats. It was found that drinking a low preference fluid during X radiation caused a decrease in preference while drinking the same fluid without exposure caused an increase in preference. NSA

N68-35667# Gottingen Univ. (West Germany).
BIOREGENERATION IN A CLOSED SYSTEM USING WATER ELECTROLYSIS AND BACTERIA [BIOREGENERATION IM GESCHLOSSENEN SYSTEM MIT HILFE VON ELEKTROLYSEGAS UND BAKTERIEN]
D. Hermann, E. Schuster, R. Lafferty, and J. Rudolph Bad Godesberg Bundesministerium Fuer Wiss. Forsch. Jun. 1968 65 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-46) CFSTI: HC$3.00/MF$0.65

The growth parameters for Hydrogenomonas strain H 16 were determined under conditions of continuous culture with formation of H_2-O_2 mixture by direct electrolysis of the culture medium. Using this method, a cell concentration of 3 g dryweight/l was achieved, whereas with an external gas supply the cell concentration reached 28 g dryweight of bacteria/l. Further topics to be reported on are: the development of new culture vessels, the isolation and characterization of new species and strains of

hydrogen-oxydizing bacteria, the determination of polysaccharide content, the production of bacterial mutants and metabolic regulation. The future development of an electrolysis-bacterial system for bioregeneration accompanied by oxygen and protein production is favourably viewed. Author

N68-35669# Sandia Corp., Albuquerque, N. Mex.
LASER EYE AND SKIN HAZARD EVALUATIONS
W. D. Burnett May 1968 19 p refs Presented at Am. Ind. Hyg. Conf., St. Louis
(Contract AT(29-1)-789)
(SC-RR-68-174; CONF-680503-5) CFSTI: HC$3.00/MF$0.65

Laser eye and skin hazards are evaluated by comparing direct exposure intensity levels on the surface of the eye or skin to exposure guidelines equal to threshold effect levels where the skin or cornea is affected and conservatively safe levels based on worst case assumptions where the retina is affected. Equations are presented for calculating the exposure intensity when the laser beam parameters and the range are known. Intensity amplification factors of the eye are indicated for the three cases encountered in practice: where simple geometric optics apply, where the laser beam divergence angle is limiting, and where Fraunhofer diffraction effects are limiting. Diffraction effects predict the maximum eye intensity amplification and hence define the worst case for retinal exposure. The resultant exposure guidelines are summarized and estimates made of the associated safety factors. Author (NSA)

N68-35670# Oak Ridge National Lab., Tenn.
BIOHAZARDS OF AEROSPACE NUCLEAR SYSTEMS
Dec. 1967 35 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-CR-67-2845) CFSTI: HC$3.00/MF$0.65

In support of the aerospace nuclear safety program, analytical and experimental studies were made on the potential hazards in the use of $^{238}PuO_2$. These studies included calculations which showed that for a sedentary subject no microsphere of PuO_2 larger than 170 microns could be inhaled into the nose. A computer program was written to determine various fluid dynamical properties of particles having densities from 1 to 12 grams/cm^3. Dosimetric studies included calculations of the α, γ, and neutron dose rates to tissue from the microspheres. Dose rates from the α emission were orders of magnitude higher at close distances than the other radiation emitted. Measurements of the 17 KeV x ray from ^{238}Pu showed greatly decreased transmission through polyvinyl chloride as compared with a plastic material that did not contain chlorine. In manipulating the $^{238}PuO_2$ particles it was discovered that the clean microspheres contaminated the probes, container, and counting equipment with which they come in contact. Author (NSA)

N68-35762# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
NEW TYPES OF SPARK-CHAMBERS FOR IMAGING γ OR X EMITTERS AND THEIR MEDICAL APPLICATIONS [NOUVEAUX TYPES DE CHAMBRES A ETINCELLES DESTINEES A LOCALISER DES CORPS RADIOACTIFS EMETTEURS DE RAYONS X OU γ ET LEUR APPLICATION EN MEDECINE]
Jean Leloup (Ph.D. Thesis—Paris Univ.) 1967 120 p refs In FRENCH
(CEA-R-3320)

In order to adapt spark-chambers to low-energy particles, a first attempt was made using a two-electrode device operating as a proportional counter. The signal obtained triggers a high-voltage pulse which is applied to the same device and a spark occurs near the track of the particle. A three-electrode device including a detection space associated to the sparks space was then used. The spark was formed spontaneously at the point where the particle passed when suitable direct-current voltages were applied to the electrodes; the high voltage is slightly lower than on the other types of chamber. This phenomenon makes the three-electrode device very easy to use for X or γ rays. The characteristics of the first device filled with argon and methane are given and the first results obtained in the medical field with a device filled with xenon methylal are presented. Author (NSA)

N68-35763# Brussels Univ. (Belgium).
RADIOBIOLOGICAL APPLICATIONS OF CELLULAR PHYSIOLOGY [APPLICATIONS RADIOBIOLOGIQUES DE LA PHYSIOLOGIE CELLULAIRE.] Final Report, 1961–1966
Dec. 1967 138 p refs In FRENCH
(Contract EURATOM-004-59-12 BIAB)
(EUR-3607)

A coordinated effort was carried out to analyze the mechanisms controlling protein synthesis in biological systems of growing complexity: bacteriophages, bacteria, unicellular algae (Acetabularia), the egg in the various stages of its development diffentiated or cancerous cells, the adult mammal. Genetic, biochemical, biophysical, and cytochemical methods were combined to achieve this end. The results obtained should form a useful basis for the study of the effects of radiation at molecular level. Author (NSA)

N68-35769*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECT OF TIME OF HEATING ON THE THERMAL POLYMERIZATION OF L-LYSINE
Milton R. Heinrich, Duane L. Rohlfing, and Ester Bugna 3 Sep. 1968 25 p refs
(NASA-TM-X-62002) CFSTI: HC$3.00/MF$0.65 CSCL 06A

Several parameters of the thermal polymerization of L-lysine free base at 195°C were investigated over the time period from 15 minutes to 4 hours. Free lysine disappeared within one hour. The concentration of α-aminocaprolactam and of oligomers of several sizes reached a maximum after 30–45 minutes, and subsequently decreased. Molecular size, as judged by biuret color intensity and by gel filtration, increased rapidly and, in part, ultimately exceeded 100,000. Racemization was extensive and paralleled the disappearance of free lysine. Catalytic activity for the decarboxylation of oxaloacetic acid increased rapidly and reached a maximum after 2 hours. Dinitrophenylation and subsequent hydrolysis indicated that the polymers were branched, and that the linear portions contained more ϵ- than α-peptide bonds. A partial understanding of the method of chain growth could be inferred. Author

N68-35779# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
CONTRIBUTION TO THE STUDY OF PLASMATIC FIBRINOGEN AND SERUM ALBUMIN: EFFECTS OF IRRADIATION [CONTRIBUTION A L'ETUDE DU FIBRINOGENE ET DE LA SERUM-ALBUMINE PLASMATIQUES EFFETS DE L'IRRADIATION]
Michel Suscillon (Ph.D. Thesis—Grenoble Univ.) 1967 119 p In FRENCH
(CEA-R-3012)

Effects of low-energy X-rays on properties and structure of serum albumin and fibrinogen were studied. A technique for amperometric determination of the fibrin stabilizing factor is presented. The kinetics of fibrin formation was studied by means of spectrophotometry. Platelet fibrinogen was demonstrated and determined quantitatively. NSA

N68-35831# Oak Ridge National Lab., Tenn.
ALGAM: A COMPUTER PROGRAM FOR ESTIMATING INTERNAL DOSE FROM GAMMA-RAY SOURCES IN A MAN PHANTOM
G. C. Warner and A. M. Craig, Jr. 10 Jun. 1968 11 p ref
(Contract W-7405-ENG-26)
(ORNL-TM-2250) CFSTI: HC$3.00/MF$0.65

A brief description of ALGAM, A Monte Carlo computer code for estimating internal dose in a man phantom from a variety of gamma-ray exposure situations, is given. Author (NSA)

N68-35844# Oak Ridge National Lab., Tenn.
COMPUTER PROGRAM FOR INBRED AND/OR HYBRID ANIMAL BREEDING AND PRODUCTION COLONIES
B. S. Bishop (Union Carbide Corp.) and M. G. Hanna, Jr. Jul. 1968 145 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2210) CFSTI: HC $3.00/MF $0.65

Five computer programs were developed to process records on animal breeding and production colonies. The programs provide means for creating and maintaining complete master records on the lineage and current status of the colonies and for, listing as output, supervisory action that has been taken as well as naintenance duties that should be performed. The programs were written in the COBOL language for the IBM-7090 computer. Author (NSA)

N68-35855# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
NUCLEAR PYKNOSIS AND THE DEVELOPMENT OF RADIATION DAMAGE IN PERIPHERAL LYMPHOCYTES
J. F. Scaife Jun. 1968 12 p refs
(EUR-3939.e)

An evaluation of a system of biological dosimetry based upon the development of nuclear pyknosis in peripheral lymphocytes in vitro, showed the system to be reproducible in rats and rabbits with a linear response up to 100 R, and a sensitivity of 5 R with results available after 7 hours. With human lymphocytes 24 hours were required to produce an equivalent response which varied from individual to individual and hence can not be established as an overall invariable method of dosimetry. Rabbit lymphocytes labelled with ^{3}H-cytidine were found to disappear from the peripheral circulation very rapidly after reinfusion into the same animal. They were essentially all gone after 60 to 90 min and no difference in the rate of elimination could be discerned for normal or irradiated (200 R) lymphocytes. Author (NSA)

N68-35867# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
TABLES OF LIMITING *t* VALUES FOR PROBABILITIES TO THE NEAREST .001 (n = 2–16) Final Report, Sep. 1966–Aug. 1967
Theodore E. Cotterman and Patricia A. Knoop May 1968 56 p refs
(AMRL-TR-67-161; AD-673347)

Tables of t to the nearest .00001 for probabilities within the range of .000 to .500, by increments of .001, are presented for samples of 2 through 16. The 't' values given are the limiting or boundary values having the indicated probability, rather than the closest approximation, thus making interpolation necessary in typical use. The tables are intended primarily as an aid in implementing a purposive probabilistic approach to psychological measurement in which the 't' distribution (or some other appropriate model) is used as a reference in deriving probabilistic behavioral measures. Secondarily, they also may be used to achieve greater precision in specifying the critical 't' for conventional tests of significance. The manner of use is briefly explained, and the way in which they were constructed is described. The Fortran computer program used in constructing them is included. Author (TAB)

N68-35860# Naples Univ. (Italy).
THE EFFECT OF IONIZING RADIATION ON DEVELOPMENT OF EMBRYONIC MOUSE ORGANS Final Report
Elio Borghese Mar. 1968 10 p
(Contract AT(30-1)-3355)
(NYO-3355-31) CFSTI: HC $3.00/MF $0.65

Studies were conducted on the effects or radiation on development of lungs, salivary glands, and kidneys. Effects of X radiation on lung tissue explanted from embryos at the eleventh day of gestation and cultured in vitro were determined. It was found that epithelial growth was enhanced by mesenchyme. X radiation applied in doses from 50 to 400 R inhibited growth. Correlation of lung epithelial growth rate with mitotic rate was studied by means of colchicine treatment. Salivary glands were explanted from embryos at the 13th day of gestation and cultured for seven to nine days; growth was inhibited by X radiation doses of 100 to 500 R. Kidney tissues were explanted at the eleventh day of gestation and studies on development in vitro showed that growth was severely retarded in comparison with normal growth. Studies on ossification in vitro were conducted by explanting cartilaginous anlage of the humerus, radius, and ulna from embryos on the thirteenth day of gestation. NSA

N68-35897# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
EFFECT OF HIGH-ENERGY ELECTRONS ON THE SKIN AND UNDERLYING TISSUES OF THE RABBIT: CLINICAL AND HISTOLOGICAL STUDY [EFFECTS DES ELECTRONS DE HAUTE ENERGIE SUR LA PEAU ET LES TISSUS SOUS-JACENTS DU LAPIN: ETUDE CLINIQUE ET HISTOLOGIQUE]
Gerard Legeay, Henry Vialettes, Jean-Jacques Adnet, Louis Court, and Roland Masse Nov. 1967 45 p refs In FRENCH
(CEA-R-3294)

After briefly considering the mechanism of interaction between the electrons and matter as a function of their energy, the dosimetry carried out as a function of the irradiation device is described. The animals received surface doses of 5,700 to 22,100 rads in the thigh; the electron energy varied from 21 to 30 MeV. Author (NSA)

N68-35907# Max-Planck-Institut fur Arbeitsphysiologie, Dortmund (West Germany). Biomechanische Abteilung.
THEORY OF TOLERANCE TO IMPACT FOR HUMANS [THEORIE DER ERTRAEGLICHKEIT VON STOESSEN FUER DEN MENSCHEN]
R. R. Coermann Jul. 1968 55 p refs In GERMAN Sponsored by Bundesministerium Fuer Wiss. Forsch.
(BMwF-FB-W-68-52) CFSTI: HC $3.00/MF $0.65

In the frequency range 0–9 Hz the human body may be considered in longitudinal direction as a simple one degree of freedom system with a damping factor of d = 0.3. Since the tolerance to impact is determined by the relative displacement of the effective mass, the deformation of such a system with and without damping by impacts with different time history has been calculated. Due to impedance measurement on a centrifuge the non-linear properties of the human body were known. The calculation of the deformation of such a non-linear system has shown that the stress may be much higher than in a corresponding linear system. The optimal elastic properties of protective devices were discussed. Author

N68-35953# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
THE ASSESSMENT OF SKIN DOSE AND THE DEVELOPMENT OF THE SURVEY METER TYPE BP3
T. S. Playle and W. N. Walker May 1968 23 p refs
(RD/B/N-1107)

The criteria involved in the measurement of dose to the skin are reviewed, and the relevant characteristics of several types of radiation detectors which might be used in a portable survey meter for estimating this hazard are compared. A description is given of an instrument based on a shallow ionization chamber which was designed and built for this purpose; it incorporates a field effect transistor electrometer which provides a logarithmic response over the range 50 mRem hr^{-1} to 500 Rem hr^{-1}. Author (NSA)

N68-35966# Federal Aviation Administration, Oklahoma City, Okla. Civil Aeromedical Inst.

CIRCADIAN RHYTHMS AND THE EFFECTS OF LONG DISTANCE FLIGHTS

Stanley R. Mohler, J. Robert Dille, and Harry L. Gibbons Apr. 1968 9 p refs Presented at Am. Public Health Assoc. Meeting, Miami Beach, Fla., 23–27 Oct. 1967

(AM-68-8; AD-672898)

Air travelers crossing four or more time zones experience significant desynchronization of certain daily biologic rhythms. Until rephasing of the rhythms occurs relative to the solar cycle at the destination, some subjective discomfort and disruption of psychophysiologic responses can occur. This paper reviews research on diurnal rhythms, discusses the implications for aircrew and passengers, and makes recommendations for reducing the effects of time zone displacements. Author (TAB)

N68-35972# Joint Publications Research Service, Washington, D. C.

BIOELECTRICAL ACTIVITY OF THE HUMAN BRAIN UNDER CONDITIONS OF DEEP WATER DIVES

A. V. Turgina and I. A. Aleksandrov 19 Sep. 1968 6 p refs Transl. into ENGLISH from Voyenno-Med. Zh. (Moscow), no. 8 p 47–50

(JPRS-46460)

Increase in irritability of the nerve cells of the brain is reported during dives to depths of 160 meters or more, but the intensive excitation process that developed lasted for only 1 to 4 minutes after exposure to such underwater depths. The EKG's then maintained a stable state throughout the remainder of the underwater exposure, although recordings were usually above normal. The EKG recordings exhibited more pronounced excitation during decompression following return from the underwater stay; and biological activity was unstable throughout the decompression period. This was particularly pronounced for the frontal regions of the brain. It is noted, however, that this excitation did not limit the normal activity of the divers. M.W.R.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-34881*# McDonnell-Douglas Co., Newport Beach, Calif. Astropower Lab.

SPACE CABIN ATMOSPHERE CONTAMINANT DETECTION TECHNIQUES

Norman R. Byrd Jul. 1968 192 p refs

(Contract NAS12-15)

(NASA-CR-86047; SM-48446-F) CFSTI: HC $3.00/MF$0.65 CSCL 06K

The objectives of this work were: (1) to obtain semiconducting polymers having maximum unsaturation and having film-forming capability; (2) to prepare sensors with candidate polymers; (3) to evaluate sensor preparation and response characteristics to various contaminants; and (4) to analyze a multiple sensor for space cabin use. A literature search was made which covered the use of adsorption methods, mass spectrometry, spectrophotometry, electronic systems, and other gas detection techniques. The preparation and derivatives of poly (phenylacetylene) for use in the sensors are described. The electrical properties of the polymers were investigated, including the effect of structure and morphology on the electrical characteristics, the electrical response of organic semiconductors, and charge transfer complexes. Gas-polymer interactions and response characteristics were measured with finger electrode and lock-and-key electrode geometries. The effectiveness of combination organic-inorganic devices was studied. A prototype portable two-sensor gas detector is briefly described which uses poly (p-nitrophenylacetylene) and poly (p-aminophenylacetylene) as the sensing polymers, cast as thin films on the lock-and-key electrode geometry. K.W.

N68-34894# Bureau of Mines, Pittsburgh, Pa.

LOW-TEMPERATURE PERFORMANCE OF COMPRESSED-OXYGEN CLOSED-CIRCUIT BREATHING APPARATUS

E. J. Kloos, A. J. Beckert, and R. H. Schultz Oct. 1968 15 p refs

(BM-RI-7192)

Two self-contained breathing apparatus of the closed-circuit compressed-oxygen type were evaluated for performance at 32° to −25°F. Low-temperature effects of oxygen and carbon dioxide concentration, visual properties of the facepiece, and mechanical operation of the apparatus were studied. Although operation varied with the wearer, his breathing rate, the apparatus precooling time, and the temperature, results suggest that general use of currently approved compressed-oxygen closed-circuit breathing apparatus be limited to temperatures above 32°F. Author

N68-34929# Joint Publications Research Service, Washington, D. C.

FP FIBROUS FILTERING MATERIALS

I. V. Petryanov, B. I. Kozlov, P. I. Basmanov, and B. I. Ogorodnikov 12 Sep. 1968 79 p refs Transl. into ENGLISH of the book "Voloknistyye Fil'truyushchiye Materialy FP" Moscow, Znaniye Press, 1968 78 p

(JPRS-46419) CFSTI: HC $3.00/MF $0.65

The use of FP (Petranov filters) filtering materials is discussed in terms of fine air purification at atomic installations and research facilities requiring air purification control methods. These FP filters, consisting of ultrafine polymer fibers, are highly effective in retaining the finest particles including those with relatively low hydrodynamic resistance. A series of short reports discusses aerosols, their particle sizes, stability, physico-chemical properties, and optical properties; and the observation and danger of highly dispersive aerosols. Structure, shape and size, properties, and service life of FP filtering materials are considered; and attention is given to protection of the respiratory organs and various air purification techniques. M.W.R.

N68-35053 Fordham Univ., New York.

ACCURACY OF POSITION JUDGMENTS OF STATIONARY TARGETS YIELDED BY THREE TYPES OF PERCEIVER OF THE AMES TRAPEZOID ILLUSION

Mary Carol Cahill (Ph.D. Thesis) 1967 119 p

Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-11483

The rationale of this research was that ability to perceive correctly the orientation of a stationary target form in space is related to the amount of apparent reversal seen when the target is rotated. The hypothesis was that Perceiver Groups which differed in the extent to which they perceived the reversal illusion would be significantly differentiated in terms of judging accuracy. It was expected that the High Group of reversal perceivers would have the greatest number of incorrect judgments, the Intermediate Group the next greatest, and the Low Group the least. In the first phase of the experiment, the three members of each Perceiver Group observed each of four targets (windowed and windowless trapezoids and rectangles) in rotation at each of five viewing distances, recording the number of apparent reversals seen under each condition. The second part of the experiment was also designed to provide information on the effects on judging accuracy of distance, target form, and target windowedness. Dissert. Abstr.

N68-35102*# Lafayette Clinic, Detroit, Mich.
SYSTEM AND PROCESS DEVELOPMENT FOR SELECTION OF HIGH STRESS TOLERANCE PERSONNEL
Albert F. Ax Washington NASA Sep. 1968 84 p refs
(Contract NAS2-1031)
(NASA-CR-1122) CFSTI: HC$3.00/MF$0.65 CSCL 06B

A system was developed for digital computer processing of psychophysiological data. It employs oscilloscope and oscillograph display, analog magnetic tape storage, A/D conversion, digital tape storage and a large digital computer (IBM 7094). The computing programs developed select all points of interest and compute their type, time of occurence, amplitude and curvature. Two substantive studies were completed. The classical conditioning of autonomic responses in schizophrenia and healthy subjects demonstrated a marked impairment in the performance of autonomic conditioning by schizophrenic patients. A pilot study of non-schizophrenic low motivation subjects revealed a disability for autonomic conditioning similar to that found in chronic schizophrenia. These findings suggest that autonomic conditioning may serve as an index for the diagnosis of both schizophrenia and low motivation and permit the speculation that a low aptitude for autonomic learning may be a contributing factor to both schizophrenia and low social motivation. Finally a study of physiological concomitants of psychological differentiation suggests that the degree of autonomic response differentiation may be correlated with the cognitive style of perceptual discrimination. Author

N68-35109*# Stanford Research Inst., Menlo Park, Calif.
RESEARCH STUDY OF A FUNDUS TRACKER FOR EXPERIMENTS IN STABILIZED VISION
D. H. Kelly and H. D. Crane Washington NASA Sep. 1968 49 p refs
(Contract NAS2-3995)
(NASA-CR-1121) CFSTI: HC$3.00/MF$0.65 CSCL 06B

An image stabilization method is discussed that involves the tracking of retinal blood vessels amd other structures of the back of the eye—i.e., a fundus tracker. The method involves projecting a scanning pattern onto the retina, and detecting the translational and rotational movements of the reflected pattern by means of a certain type of high-speed correlation processing of the video signal. A particularly simple, circular scan method for this purpose is implemented by inverting a standard fundus camera in order to project the scan pattern onto the retina. The correlation processing is presently simulated on a digital computer at slow speed. This simulation program will be used for overall evaluation of the tracking system as well as to help in design of the required high-speed correlation equipment. This fundus tracker technique may provide greater precision of tracking than is provided by contact-lens techniques, as well as the potential for greater convenience of use. Author

N68-35135# California Univ., Livermore. Lawrence Radiation Lab.
TECHNIQUES FOR REDUCING ELECTRICAL NOISE PICKUP IN BIOMEDICAL COUNTING INSTRUMENTATION
Paul L. Phelps, Frank A. Newbold, and Douglas L. Sawyer *In its* Noise Reduction Conf. [1968] p 205-212 refs (See N68-35118 22-23)

An x-ray spectrochemical system used for the elemental analysis of biological tissues was found to be producing data that deviated from the expected statistical limitations. The associated electronic detection system consisted of a photomultiplier, preamplifier, linear amplifier and single channel discriminator. Several sources of electrical interference were discovered near the system and at remote points and shown to be the cause of erratic data. Electrical radiation from oscillating fluorescence lamps was judged to be the chief source of noise. Also other electrical distrubances were found to be conducted to the system via power lines and the electrical ground. The preamplifier was repackaged, suitable filters incorporated into the supply voltage leads, all cables were shielded and properly grounded, and a new electrical ground was established. The system is judged now to be immune from the sources of noise encountered and has performed satisfactorily for more than 24 months. Author (NSA)

N68-35155*# General Dynamics/Convair, San Diego, Calif. Life Sciences Lab.
FEASIBILITY STUDY OF A CENTRIFUGE EXPERIMENT FOR THE APOLLO APPLICATIONS PROGRAM. VOLUME 4: MANNED CENTRIFUGE TEST REPORT Final Report
15 Aug. 1968 77 p refs
(Contract NAS1-7309)
(NASA-CR-66684; GDC-DCL-68-004; SRC-MS-302) CFSTI: HC $3.00/MF$0.65 CSCL 06B

Oculogyral illusion (OGI) threshold for cross-coupled acceleration was studied with 10 qualified SCUBA personnel who passed Class III flight physicals, as was the vestibular cross-coupled acceleration threshold for Response Analysis Tester (RATER) performance degradation with resultant acceleration in pitch plane. The OGI experiment demonstrated the importance of relative time for tilts to produce equivalent acceleration. In the RATER experment, even the most severe dynamics did not result in any appreciable degradation in overall test performance, and no nausea or stomach disturbance was detected in any of the subjects. Passive tilting, with the RATER task display fixed relative to the subject, appeared to result in adequate visual stabilization to discourage spatial disorientation. These ground based experiments were made to enable prediction of stability control requirements and subject tolerance limits for an orbital centriguge concept in connection with the Apollo Applications Program. Physiological implications, vectoroculograph and electro-oculograph recordings, and the dynamic analysis of cupular stimuli are discussed; along with the test facility design and operation. M.W.R.

N68-35156*# Denver Univ., Colo. Dept. of Chemical Engineering.
CYCLIC OPERATION OF ADSORPTION BEDS FOR USE IN SPACECRAFT LIFE SUPPORT SYSTEMS Semiannual Report, 15 Dec. 1967–15 Jun. 1968
Lawrence W. Ross Jul. 1968 11 p refs
(Grant NGR-06-004-068)
(NASA-CR-96949) CFSTI: HC$3.00/MF$0.65 CSCL 05K

A mathematical model was developed for the carbon dioxide adsorption system behavior of the Apollo spacecraft life support system in order to study the application of cyclic modes of operation to a recovery system. The equilibrium relation between solid-phase concentration and interfacial gas-phase concentration of CO_2 was assumed to be linear for mass transfer during adsorption. Axial diffusion made no significant contribution to the gas phase equation, and heat transfer equations for the gas and solid phases had the same form. Data from measurements made by a prototype adsorption unit showed that the model closely matched results if a mass transfer coefficient of k = 7 was assumed; a value of 5.7 was reported from diagrams that did not use the proposed model. M.W.R.

N68-35180*# Case Western Reserve Univ., Cleveland, Ohio. Solid State Electronics Lab.
[INVESTIGATION OF IMPLANTABLE MULTICHANNEL BIOTELEMETRY SYSTEMS] Semiannual Report Sep. 1967–Feb. 1968
W. H. Ko, E. Yon, W. Thompson, and D. Ramseth Jul. 1968 13 p *Its* Case No. 42-364
(Grant NGR-36-003-079)
(NASA-CR-96891; SAR-4) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Progress in the development of multichannel, physiologically implantable telemetering systems for biological measurements is reported. A single-channel FM/FM strain gage transmitter implanted in a dog one year ago continues to function except for a strain

gage pickup failure. Performance and operational maintenance of an implanted four-channel transmitter system is discussed. Telemetering both ECG and EEG signals with an eight-channel transmitter setup is briefly described. A receiving and demodulating system was expanded to accept eight channels of information. An active, low-pass filter with a break point of 150 Hz was bread-boarded and incorporated into the output circuitry of sample and hold circuit boards in the demodulator. The filter was used in the demodulation of the ECG and EEG signals. Circuitry was breadboarded to allow the demodulator to accept variations in the transmitter ring-oscillator frequency, thus making possible the use with several transmitter systems without demodulator ring oscillator adjustment. K.W.

N68-35219# Tufts Univ., Medford, Mass. Human Engineering Information and Analysis Service.
TRENDS AND DEVELOPMENTS IN VISUAL DISPLAYS Final Report
Mason N. Crook, Margaret W. Raban, and Edward A. Wade Dec. 1967 68 p refs
(Contract Nonr-494(13))
(HEIAS-107; AD-673091)

Selected emphases in the literature of displays are surveyed, including: approaches directed at systematizing one aspect or another of the field; reviews and techniques concerned with comparative evaluations within particular display categories; characteristics of the operator, which are important for display design; recent developments (pictorial displays especially) divised to exploit more fully the operators capacities; and potential new areas of display application. Author (TAB)

N68-35233# System Development Corp., Santa Monica, Calif.
UPDATING SOME GROUND RULES FOR MAN-MACHINE SIMULATION
R. J. Meeker and G. H. Shure Apr. 1968 15 p refs
(Contract DAHC15-67-C-0277)
(SDC-SP-3143; AD-672783)

This paper proposes to show that the techniques and research designs borrowed from the highly abstract, sterilized, easily replicable experiments of the social scientist are, in part, responsible for the failure both to evaluate simulation methodology and to make significant research gains through simulation studies. With the availability of a large-scale, computer-based laboratory, techniques are now available for overcoming many of the serious limitations associated with the problems of data collection and analysis, particularly the difficulty of timely assessment and recording of data on large number of subjects in the precise detail and volume required; and secondly, the problem of usefully analyzing such an enormous and complex body of data. We propose to show that in our own research program the use of large-scale computer-based laboratory permits significant inroads to be made into methodological and validity problems of simulation, which remain relatively intractable under attacks of a smaller scale. Author (TAB)

N68-35346# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BIOELECTRIC CONTROL [BIOELEKTRICHESKOYE UPRAVLENIYE]
I. Akulinichev 28 Sep. 1967 9 p Transl. into ENGLISH from Med. Gazeta (Moscow), 25 Feb. 1966 p 1
(FTD-HT-67-282; AD-672910)

The document discusses the history and development of prosthetics, especially as it relates to bioelectrically controlled forearm prostheses. Prominent personalities in the development of bioelectric prosthetics are noted. Studies of bioelectrically actuated forearm prosthetics have been conducted on more than 800 invalids. The author foresees the application of the principles of bioelectrical control systems in manned spaceflight. Author (TAB)

N68-35455# Flight Safety Foundation, Inc., New York.
GENERAL AVIATION PILOT EDUCATION PROGRAM Final Report
Warren L. Cole Sep. 1967 127 p refs
(Contract FA-65-WA-1350)
(FAA-FS-67-1; AD-673159)

General Aviation Pilot Education (GAPE) was a safety program designed to improve the aeronautical education of the general aviation pilot in anticipation that the national aircraft accident rate might be improved. GAPE PROGRAM attempted to reach out to the average general aviation pilot with specific and factual information regarding the pitfalls of his contemporaries who were involved in aircraft accidents and what he could do to avoid them. The program employed statistical analyses, publications, programmed training devices, speaking presentations and surveys as the tools with which to administer the program. Author (TAB)

N68-35548*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
HUMAN TRANSFER CHARACTERISTICS IN FLIGHT AND GROUND SIMULATION FOR THE ROLL TRACKING TASK Final Technical Report
Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Apr. 1968 77 p refs Sponsored in part by NASA
(Contract AF 33(615)-3605)
(NASA-CR-97017; CAL-TE-2256-F-1; AFFDL-TR-67-30; AD-671540) CSCL 05E

The mathematical description of human pilot dynamic characteristics has been based primarily upon data obtained in constrained ground-based simulator experiments. Whether or not it is valid to extrapolate the use of these descriptions to actual flight is a prevalent question. Reported herein are data which describe the pilot's dynamics in both ground-based simulator and actual flight situations for the constrained situation of a compensatory roll tracking task. additionally, data are presented for ground-based simulator measurements of pilot dynamics as the pilot controls a simple integrator system and a divergent system. Author (TAB)

N68-35937# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ATMOSPHERE SENSING AND MAINTENANCE SYSTEM Final Report, May 1966–Apr. 1967
David J. Withey and Edward J. Glanfield Wright-Patterson AFB, Ohio AMRL Jun. 1968 47 p refs
(Contract AF 33(615)-3612)
(MSD-15226; AMRL-TR-67-147; AD-673518)

This program encompasses the analysis, design, fabrication and testing of an Atmosphere Sensing and Maintenance System (ASMS) to be used in conjunction with the Aerospace Medical Research Laboratories (AMRL) Life Support System Evaluator (LSSE) chamber or similar space cabin simulators. The ASMS is a two-gas control system capable of monitoring and controlling the total pressure and the oxygen partial pressure of the atmosphere within the LSSE. Oxygen partial pressure is controlled to plus or minus 2.5 mm Hg over the range to 100 to 250 mm of Hg and total pressure is controlled to + 7.5, - 2.5 mm of Hg over the range of 150 to 800 mm of Hg. Monitoring of the oxygen partial pressure and the total pressure of the LSSE atmosphere is possible from either the control panel or the monitors panel of the ASMS. Control of the LSSE atmosphere is possible only from the control panel. The pannels are designed to be interchangeable, to provide control capability either inside or outside of the LSSE with a minimum of effort. Author (TAB)

N68-35942# Aerospace Medical Div. Aerospace Medical Research Labs. /6570th/, Wright-Patterson AFB, Ohio.
EFFECTS OF SIMULATED TASK LOADING ON SIDE-LOOKING RADAR TARGET RECOGNITION Final Report, Jan. 1966–Mar. 1967

Almon J. Bate and Herschel C. Self Jun. 1968 43 p refs
(AMRL-TR-67-141; AD-673873)

The study was conducted to determine the effects of simulated task loads that prevented observers from devoting all of their time to searching a radar display for targets of opportunity. Task loads taking up 0%, 25%, 50% and 75% of an observers screen viewing time during 30-minute trials were simulated by turning display on and off in a programmed random pattern. Forty SAC radar navigator-bombardiers were randomly assigned to the four viewing conditions. They viewed a 5-inch wide strip of high resolution, coherent SLR film projected on a 14-inch-square display screen. The radar picture, displayed at an image scale of 1:130,000, depicted a strip of terrain 25-nautical-miles wide and traveled from the top to the bottom of the screen at a simulated aircraft speed of 1300 knots, or 12.3 inches/minute. The number of correct responses and the number of false responses were approximately linear functions of accumulated viewing time. Mean distance traveled down the screen by targets and nontargets prior to responses was also significantly affected by viewing time, with the greatest increase in travel occurring when total viewing time was reduced from 75% to 50%. Since the numbers of correct and false responses decreased in approximately the same proportion with each decrease in viewing time, overall accuracy of responses was nearly constant for all viewing times. Author (TAB)

N68-35943# Battelle Memorial Inst., Columbus, Ohio.
CARBON DIOXIDE REDUCTION AND WATER ELECTROLYSIS SYSTEM Final Report, 1 Feb. 1966–30 Sep. 1967
Byung C. Kim, Edwin S. Kolic, Robert H. Cherry, and John E. Clifford May 1968 83 p refs
(Contract AF 33(615)-3444)
(AMRL-TR-67-227; AD-673903)

An integrated system for oxygen recovery from carbon dioxide was investigated as a breadboard laboratory model of nominal 1/2-man capacity. System design for carbon dioxide reduction was based on alternate operation of two Bosch reactors with periodic cool down for removal of carbon and replenishment of catalyst. Experimental studies demonstrated attainment of the design objectives of a carbon-to-catalyst ratio above 20 and an overall carbon-packing density of 0.45 g/cu.cm. in the catalyst chamber. Degradation of Bosch reactor materials during extended operation was a problem that was not completely resolved. Experimental studies indicated that a regenerable solid-adsorbent based on combinations of silica gel and molecular sieve operating on alternate cycles of absorption and desorption can be used for efficient transfer of water vapor from the Bosch recycle gas to a water-vapor electrolysis cell. The original matrix-type water-vapor electrolysis unit with Pd-25Ag hydrogen diffusion cathodes did not perform satisfactorily and was replaced by a water-vapor electrolysis unit with phosphoric acid electrolyte for satisfactory evaluation of water-vapor transfer for the integrated system. Author (TAB)

N68-35945# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
EFFECT OF AN AUXILIARY MAGNIFICATION DISPLAY ON SIDE-LOOKING RADAR TARGET RECOGNITION Final Report, Jan. 1966–Mar. 1967
Almon J. Bate and Herschel C. Self May 1968 45 p refs
(AMRL-TR-67-134; AD-673872)

Research was undertaken to determine if an auxiliary magnified display would aid radar-reconnaissance operators in recognizing unbriefed targets. Two identical parallel-driven side-looking radar films were presented on a dual-screen rear projection console to 36 radar navigator-bombardiers from the Strategic Air Command. Subjects assigned to the control group viewed imagery on a 7-inch square main screen. Subjects assigned to each of the three treatment groups used a cross-hair location device, which permitted any portion of the imagery on the main screen to be presented on an upper 7-inch-square auxiliary screen, at 2x, 4x, or 8x magnification. The imagery traveled from the top to the bottom of the main screen at a simulated aircraft speed of 658 knots, depicting, at a scale of 1:417,000, a strip of terrain 40 nautical miles wide. Providing an auxiliary magnification display had no beneficial effect upon the number of targets correctly recognized, the number on nontargets mistaken for targets, the proportion of responses that were made to real targets, or upon response latency. Author (TAB)

N68-35959# Naval Research Lab., Washington, D. C.
THERMOLUMINESCENT DOSIMETERS FOR PERSONNEL MONITORING
F. H. Attix, F. J. West, A. E. Nash, S. G. Grobics, and T. L. Johnson [1968] 11 p refs
(TID-24522) CFSTI: HC $3.00/MF $0.65

A number of thermoluminescent phosphors are suitable for application in personnel radiation monitoring. The principal characteristics of LiF (TLD 100), CaF_2:Mn, CaF_2 (fluorite), $Li_2B_4O_7$:Mn, $CaSO_4$:Mn, and BeO are summarized. Some useful dosimeter configurations are also discussed, including a new NRL dualphosphor design that is capable of measuring the X-ray or gamma-ray effective energy as well as the exposure or dose. Relative performance results for CaF_2:Mn dosimeters versus film badges are also included. Author (NSA)

N68-35983# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
MATHEMATICAL MODELS OF HUMAN PERFORMANCE IN MAN-MACHINE SYSTEMS Final Report, Apr.–Dec. 1967
Donald A. Topmiller May 1968 21 p refs Presented to the NATO Sci. Advisory Group Symp. on the Simulation of Human Behavior, Paris, Jul. 1967
(AMRL-TR-68-22; AD-673348)

The report describes three research approaches to the problem of mathematically representing human performance parameters in weapon, maintenance, and command and control systems. In the first approach, twenty operations research analyses and models of military systems were examined to determine if the models included human factors parameters and to what extent they were sensitive to variations in these parameters. Although many of the functions of the systems modeled were performed by humans, human performance parameters were not, in general, sufficiently defined to permit mathematical or empirical manipulation within a man–machine simulation framework. In the second approach, an attempt was made to establish predictive relationships, based on regression and factor analysis techniques, between human engineering design parameters and those criteria of systems effectiveness, such as maintenance task time, that can be transformed into a more molar index-system downtime. The human engineering predictor-parameters accounted for 50% of the criterion variance. In the third approach, a series of experiments involving real-time simulation of a command and control system was conducted to determine if, and how, a computer might aid diagnostic performance (in tactical decision making) in threat evaluations. The system output or criterion of effectiveness was the degree to which the system assesses the true state of threat. With computer aiding, correct decisions increased by 13%. Author (TAB)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-34822 Michigan Univ., Ann Arbor.
REACTIONS OF THE BORANE GROUP AS A LEWIS ACID
Karen Dale Williams Morse (Ph.D. Thesis) 1967 176 p
Available from Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 67-15661

The reaction of the simple phosphine borane adduct, H_3PBH_3, with NH_3 and methylamines was found to involve an equilibrium, E, which is effected by three factors. At low temperature, in a medium containing a component of high dielectric constant, and when the acidity of the protons attached to the phosphorus is sufficiently high, the ionic species $[BASE\text{-}H^+]$ $[H_2P(BH_3)_2^-]$ is formed. The ionic product was identified by chemical reactions and by infrared and nmr spectroscopy. At highter temperatures, in a medium containing components of low dielectric constant only, and when the acidity of the phosphine protons has been reduced as by replacement of a proton by a methyl group, a simple base displacement process occurs to give $BASE\text{-}BH_3$ and PH_3. A new borane adduct was synthesized in the reaction of tetrafluorodiphosphine (P_2F_4) with diborane; the resulting borane adduct is properly formulated as $P_2F_4BH_3$. Dissert. Abstr.

N68-34824# Colorado Univ., Boulder. Dept. of Chemistry.
REACTION HEATS OF ORGANIC COMPOUNDS. PART 6: HEATS OF ADDITION OF SOME ALCOHOLS TO 1, 1-DICHLORO-2, 2-DIFLUOROETHYLENE
M. B. Kennedy, J. R. Lacher, and J. D. Park [1968] 23 p
(Grant NSF GP-5408)

A calorimeter suitable for measuring the enthalpy changes for gas-liquid reactions at 25°C and constant pressure is described. Measurements of the heats of addition of methanol, ethanol, n-propyl, and iso-propyl alcohol, to 1, 1-dichloro-2, 2-difluoroethylene in alcoholic-potassium hydroxide solutions at 25°C are reported. The data were used to show how variations in the basicity and size of the alcohol affect the stability of the resulting saturated ether. Author

N68-34832# Bureau of Mines, Pittsburgh, Pa.
BUREAU OF MINES RESEARCH ON THE ANALYSIS OF HIGH-PURITY TUNGSTEN
Oct. 1968 13 p refs
(BM-IC-8397)

This report summarizes the work on the development of analytical procedures for determining metallic and interstitial impurities in high purity tungsten. Fourteen published methods and seven unpublished methods are briefly described. Carbon, hydrogen, nitrogen, and oxygen, in microgram to higher quantity levels, can be determined by several methods. Trace levels of 29 metallic impurity elements can be determined by optical spectrography, X-ray spectrography, and other instrumental methods. Author

N68-34834# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE FORMATION AND REACTIONS OF P FERROCENEBENZALDEHYDE
Shu-Chien Sze, Hsueh-Tze Soong, and Feng-Tse Li 19 Sep. 1967 6 p refs Transl. into ENGLISH from K'o-Hsueh T'ung Pao (Peking), no. 1, 1965 p 78–79
(FTD-HT-67-222; AD-670064)

A description is given of the formation of p-ferrocenebenzaldehyde by the introduction of the aryl group into ferrocene, and of its reactions. The physical constants and data for microanalysis of the related compounds are given in tabular form. TAB

N68-34871 National Lending Library for Science and Technology, Boston Spa (England).
A POLAROGRAPHIC CELL FOR THE QUANTITATIVE DETERMINING OF DISSOLVED OXYGEN [POLYAROGRAFICHESKAYA YACHEIKA DLYA KOLICHESTVENNOGO OPREDYELYENIYA RASTVORYENNOGO KISLORODA]
H. F. Sholts and D. N. Ostrovski Sep. 1968 7 p refs Transl. into ENGLISH from Lab. Delo (Moscow), no. 6, 1965 p 375–378 (RTS-4688) Available from Natl. Lending Library, Boston Spa, Engl.: 7s 6d

Development of a polarographic cell for quantitative determination of oxygen in different solutions is described. Temperature control was achieved by a flow of liquid inside the cell, and fluctuations of current following temperature changes were almost completely eliminated by semiconducting thermoresistances. The solution whose oxygen content is being measured was agitated by a magnetic mixer located above the membrane covering the cell electrodes. M.W.R.

N68-34876 Case Inst. of Tech., Cleveland, Ohio.
AROMATIC OXYGENATION WITH PEROXYCARBONATES AND METAL HALIDES. 1. FRIEDEL-CRAFTS CATALYSTS. 2. REDOX METAL HALIDES
Michael Edward Kurz (Ph.D. Thesis) 1967 251 p
Available from Univ. Microfilms: HC $11.60/Microfilm $3.25 Order No. 67-16085

Diisopropyl peroxydicarbonate reacted with various alkylbenzenes and aromatic ethers in the presence of aluminum chloride at 0° to yield aryl carbonates initially and phenols upon work-up. Orientation and relative rates pointed to electrophilic substitution by a cationic oxygen species generated *via* heterolytic cleavage of a peroxide-catalyst complex. In a similar manner, t-butylperoxy isopropyl carbonate gave rise to oxygenation products with alkylbenzenes, but with aromatic ethers two additional modes of reaction occurred (Criegee rearrangement and t-butyl hypohalite formation), apparently also entailing heterolytic fission. Decomposition of diisopropyl peroxydicarbonate in the presence of cupric chloride and toluene in acetonitrile solvent at 60° resulted in good yields of tolyl isopropyl carbonates. Evidence pointed to a chain process involving copper halide in a redox capacity and alkoxycarboxy radicals. Nuclear attack by oxy radical possessing electrophilic character followed by rapid oxidative conversion to product by cupric chloride is proposed. Metal salts exhibiting good ligand transfer properties were superior in effecting the oxygenation transformation. Peroxides containing various structural permutations were tested in the role of oxygenating agents. Only those involving alkoxycarboxy or aroyloxy radicals as the chain transfer agents were able to bring about aromatic substitution. Dissert. Abstr.

N68-34880 Rensselaer Polytechnic Inst., Troy, N. Y.
SOME STUDIES OF THE IONIZING RADIATION INDUCED ISOTOPE EXCHANGE IN GASEOUS NITROGEN
Robert D. Brown (Ph.D. Thesis) 1967 167 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 67-12828

The gas phase isotopic ex exchange of $^{14}N_2$ with $^{15}N_2$ under ionizing radiation has been studied in a number of systems important to the ionizing radiation induced fixation of nitrogen. A limited number of experiments were done at temperatures greater than the ambient temperature of the Brookhaven National Laboratory Graphite Research Reactor. Some experiments were also performed using a ^{60}Co source and some utilizing the fission products of ^{235}U. The results indicate that a mixture of $^{14}N_2$ and $^{15}N_2$ free of oxygen or other impurities undergoes isotopic exchange to form $^{14}N^{15}N$ with a G_N value of 11.5 ± 1.0. That is, 11.5 atoms of nitrogen are involved in the formation of isotopically mixed nitrogen molecules for every 100 eV of energy absorbed by the gas mixture. The mechanisms of this isotopic exchange are believed to be the random recombination of nitrogen and a type of molecular exchange. The results obtained from the irradiation of mixtures of $^{14}N_2O$ and $^{15}N_2O$ were utilized in developing a new method for determining the thermal neutron component of a mixed radiation field. These same experiments showed that nitrous oxide is reformed during its decomposition and confirmed that $N_2O \longrightarrow N_2 + O$ is the primary step of the radiation induced decomposition. Dissert. Abstr.

N68-34888 Cincinnati Univ., Ohio.
PROPERTIES AND BONDING IN SOME PLATINUM (2) PI COMPLEXES
Phyllis Deen Kaplan (Ph.D. Thesis) 1967 160 p
Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 67-15967

The preparation and properties of some 1 [4 Z pyridine N oxide] 3 un 2,4 dichloroplatinum(II) complexes (where un = olefin or alkyne), have been determined. Infrared studies indicate that when R is carboalkoxy there is very little effect on the olefin carbon-hydrogen absorption frequencies (R = H) other than a shifting to higher frequencies of those out-of-the-plane deformations associated with the vinyl grouping. Nuclear magnetic resonance studies indicate that "metalation" exerts a smaller effect on the ring protons of the N-oxide than protonation in an aqueous medium. Dissert. Abstr.

N68-34895 California Univ., Berkeley.
HIGH RESOLUTION MASS SPECTROMETRY: TECHNIQUES AND APPLICATIONS TO MOLECULAR STRUCTURE PROBLEMS
Dennis Howard Smith (Ph.D. Thesis) 1967 263 p
Available from Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 67-11666

The technique of high resolution mass spectrometry is being applied to an ever-increasing extent in studies on molecular structures. The technique combines the inherent sensitivity of a mass spectrometer with the facility for determining the elemental compositions of molecules and their fragments. The necessary techniques for determining complete high resolution mass spectra are discussed. This includes a description of the instrumentation employed and the methods used to record the spectra on photographic plates and, subsequently, to measure the relative positions of all lines on the photoplate. Computational methods for translating measured line positions from a calibration compound with those from the compound of interest are discussed. Methods for determining possible elemental compositions for each line based on the calculated accurate masses are also discussed. Dissert. Abstr.

N68-34900 Texas Univ., Austin.
SOME APPLICATIONS OF SPIN-FREE QUANTUM CHEMISTRY
Antonio Arnoldo Cantu (Ph.D. Thesis) 1967 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-14810

Only polyelectronic systems which are adequately described by a spin-free Hamiltonian are considered. Thus the space of the system, over which the Hamiltonian operates, is also spin-free. For an N-electron system, the Hamiltonian commutes with elements of the permutation group S_N and consequently the space of the Hamiltonian can be factorized into subspaces, called permutation states, each of which is characterized by a partition [λ] of N. A partition also indexes an irreducible representation of S_N. The Pauli principle states that only permutation states characterized by $[\lambda] = [2P, 1^{N-2P}]$, $0 \leq p \leq N/2$, are allowed in nature. Dissert. Abstr.

N68-34905 Delaware Univ., Newark.
A STUDY OF THE SURFACE SELF-DIFFUSION OF IRON
John Mortimer Williams (Ph.D. Thesis) 1966 252 p
Available from Univ. Microfilms: HC $11.50/Microfilm $3.25 Order No. 67-11751

A knowledge of the surface mobility of metal atoms would be of inestimable value for increased understanding of such phenomena as catalysis or oxidation. Therefore, to elucidate the surface behavior of metals a study of the surface self-diffusion of iron was conducted. After consideration of previous inquiries the tracer-auto-radiographic technique was selected as being the most useful in view of the various factors to be investigated. In this method a small quantity of radioactive material (Fe^{59}) was introduced onto a prepared surface and the specimen annealed at the desired conditions of temperature and atmosphere. An auto-radiograph was then made of the surface to determine the redistribution of the tracer material, and hence the surface self diffusion coefficient. Dissert. Abstr.

N68-34934 Washington State Univ., Pullman.
ELECTRON DESORPTION OF ACTIVE GASES FROM TUNGSTEN
Donald Richard Sandstrom (Ph.D. Thesis) 1967 68 p
Available from Univ. Microfilms: HC $3.80/Microfilms $3.00 Order No. 67-15762

Ions released by electron impact from a layer of carbon monoxide adsorbed on the (211) face of tungsten were shown to be O^+ by a direct mass spectrometric technique. No CO^+ ions were observed. It was observed that O^+ ions were released from each of two surface states, the α phase of carbon monoxide and an oxygen impurity layer produced by electron impact induced dissociation of carbon monoxide. A mathematical model is presented describing the kinetics of desorption via dissociation. The total electron impact desorption cross section for the α phase of carbon monoxide was found to be $2.8 \pm 0.3 \times 10^{-18}$ cm^2, and that from the oxygen layer $1.0 \pm 0.3 \times 10^{-18}$ cm^2. Agreement is obtained with the Roberts-Miller theory for the adsorption into the α phase of carbon monoxide for relative surface coverages less than 0.8, and reasons for the deviation above this figure are proposed. Dissert. Abstr.

N68-34935 Purdue Univ., Lafayette, Ind.
SOME ORTHOSILICATES AND THEIR HYDRATES
Larry Edwin Campbell (Ph.D. Thesis) 1967 168 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 67-16622

The reactions of several alkaline-earth orthosilicates with water were studied. The compounds used were the orthosilicates of barium, strontium, and calcium, the last in both the β and γ phases. The objectives of the study were to determine the processes of the early hydration reactions, the activation energies, and to relate any differences to structural differences in the compounds. A secondary objective was to study the final products of the reaction. The anhydrous silicates were prepared by ignition of silicic acid and the appropriate carbonate in a tube furnace. The anhydrous silicates were mixed with an amount of water large enough so that, at least for an appreciable initial time, no saturation of the water with dissolved species occurred. The reaction variables controlled were the sample size, the initial concentration of the alkaline-earth hydroxides in solution, the temperature, and the specific surface area of the orthosilicates. A consideration of the equivalent conductances of the various products that could have been formed by the reaction showed that the species produced in solution in all cases was the dibasic orthosilicate ion, $H_2SiO_4^{-2}$. Dissert. Abstr.

N68-34936 Ohio State Univ., Columbus.
MECHANISM OF REACTIONS OF NICKEL (2) COMPLEXES OF MERCAPTOAMINES WITH ALKYL HALIDE
Elliott Lawrence Blinn (Ph.D. Thesis) 1967 418 p
Available from Univ. Microfilms: HC $18.90/Microfilm $5.35 Order No. 67-16259

The synthesis and characterization of the complexes Ni-($Me_2NCH_2CH_2S)_2$, Ni($RNHCH_2CH_2S)_2$ (R = n-propyl, n-octyl, or n-decyl), $Ni[NH_2CH(CO_2Et)CH_2S]_2$ and other more complicated but related nickel(II) complexes has made possible the study of the effects of structural parameters on the kinetics of the reactions of the coordinated mercapto group with alkyl halides. Various p-substituted benzyl bromides and a number of alkyl halides were investigated. Spring syringe and the usual spectrophotometric methods permitted study of all reaction processes having half lives in excess of several seconds. All observations are consistent with competition between reaction paths that either do or do not

involve preequilibrium complex formation between the alkyl halides and the nickel(II) of the mercaptoamine complex. Dissert. Abstr.

N68-34974 Pennsylvania State Univ., University Park.
A DIELECTRIC STUDY OF THE LOW TEMPERATURE MOLECULAR MOTIONS IN POLYSTYRENE AND THE POLY(O-, M-, OR P- CHLOROSTYRENE)S
Raymond George Saba (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-15414

The purpose of this investigation was to obtain experimental data for polystyrene and the poly(o-, m-, or p-chlorostyrene)s and to interpret them in the hope of obtaining an understanding of the micro-motion responsible for the loss peak previously observed in polystyrene in the neighborhood of 45°K. The dielectric techniques employed were capable of yielding reliable and precise measurements on polymers over broad ranges of frequency (100 Hz - 20 kHz) and temperature (4.2°-350°K). The polymers were compression molded into thin, circular, parallel-sided discs. The dielectric constant and loss of these samples were measured from 4.2°-300°K at eight fixed frequencies of 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0 and 20.0 kHz in a combined dielectric and dilatometric cell which also enabled the thermal expansion of the samples to be determined. Dissert. Abstr.

N68-35015 South Carolina Univ., Columbia.
FAR INFRARED SPECTRA AND STRUCTURE OF PALLADIUM (2) AND PLATINUM (2) COMPLEXES AND THE VIBRATIONAL SPECTRA OF SOME ORGANOPHOSPHORUS COMPOUNDS
Bruce Richard Mitchell (Ph.D. Thesis) 1967 63 p
Available from Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 67-15589

The infrared spectra of a number of cis and trans palladium(II) complexes of the type PdL_2X_2 have been recorded from 600 to 250 cm^{-1}. The Pd-Cl stretching frequencies range from 360 to 287 cm^{-1}. The Pd-N stretching frequencies ranged from 528 to 436 cm^{-1}. The positions of the Pd-Cl bands are correlated with those expected from a trans effect which is due to both bond weakening and π-bonding phenomena, depending upon the type of ligand. It is shown that the increasing order of NH_3, $ArNH_2$ and RNH_2 as trans directors is due mainly to bond weakening, while the position of pyridine and R_2S as trans directors is due to both π-bonding and bond weakening. The infrared spectra of several square planer cis and trans palladium(II) and platinum(II) complexes of the type MPy_2X_2 and $Pd(Bipy)X_2$ (Py = pyridine; Bipy = bipyridine; X = Cl, Br or I) have been recorded from 2000 to 50 cm^{-1}. Comparison of the spectra of complexed pyridine to that of the free base shows nine normal vibrations have shifted to higher frequencies on the order of fifteen to eighty wavenumbers. Dissert. Abstr.

N68-35018 Harvard Univ., Cambridge, Mass.
APPLICATIONS OF MICROWAVE SPECTROSCOPY TO SOME INORGANIC FLUORIDES
Joseph Fratus Martins (Ph.D. Thesis) 1967 94 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-14122

The microwave spectrum of Xenon Oxytetrafluoride ($XeOF_4$) has been observed in seven isotopic species and three excited vibrational states. The molecular structure of this compound was determined, and a brief examination of three methods of calculating the structure from the data (single isotopic substitution, double substitution and single substitution with shrinkage corrections) was made. The dipole moment of $XeOF_4$ was measured by two methods: the rate-of-growth of line intensity with modulation amplitude, and double resonance. No lines due to quadrupole coupling of the Xenon-131 isotope were seen, and the failure to find them is justified. Certain vibration-rotation effects possible for this symmetry were also not seen. Some of the pertinent theory of the second-order Coriolis interactions is presented in a form convenient for calculation. Dissert. Abstr.

N68-35038 Northwestern Univ., Evanston, Ill.
PHOTOREACTOR ENGINEERING
Solomon Maurice Jacob (Ph.D. Thesis) 1967 128 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-15250

The analysis of perfectly mixed photochemical reactors has been tested experimentally for a non-chain liquid phase reaction system with a low absorption coefficient. The photohydrolysis of aqueous chloroplatinic acid was studied over a fourfold range of reactor path lengths. A cylindrical annular reactor with a light source along its centerline was used in most of the experimental work. Provision was made to allow the reactors to be run under both batch and flow conditions. A photoprobe was designed to determine experimental light intensity profiles in such a reactor and for an elliptical tubular reactor of the Baginski type. A method was devised to obtain the quantum efficiency of the reaction from batch experimentation conducted in the smallest reactor at different light intensities. Formulation and integration of a mathematical model of the system represents the first known rigorous point by point calculation attempted. A method of design for non-chain reactions is indicated. Predicted scale-up ratios based on such a model were in close agreement with experimental results for reactors operated under both batch and flow conditions. Author

N68-35045 Pennsylvania Univ., Philadelphia.
AN INVESTIGATION OF THE SILICON-SILICON BOND AND THE SILICON-COBALT BOND IN SELECTED COMPOUNDS
Yvonne Louise Baay (Ph.D. Thesis) 1967 335 p
Available from Univ. Microfilms: HC $15.10/Microfilm $4.30 Order No. 67-12724

In the course of this investigation reactions were studied involving the species $(SiF_2)_n$ and SiF_2, which were conveniently prepared by a high temperature, low pressure reaction: $(SiF_2)_n$ was reacted with HBr, Br_2 and the covalent halides, PCl_5, Me_2AsCl and Me_2AsF. Silicon fluorohalides were identified amongst the reaction products. In the case of the arsines, $(SiF_2)_n$ acted as a coupling agent, since $Me_2AsAsMe_2$ was produced. Me_2AsCl and Me_2AsF also cleaved the Si-Si bond in Si_2F_6 to give $(Me_2As)_2SiCl_2$ and $Me_2AsAsMe_2$, respectively. The increased reactivity of the Si-Si bond in these perfluoro-polysilanes presumably may be related to the smaller steric requirement of the fluorines and the enhancement of the silicon to nucleophilic attack by the presence of the fluorine ligands. In conclusion this investigation pointed out differences in the chemistries of compounds containing silicon and carbon atoms. Dissert. Abstr.

N68-35046 Columbia Univ., New York.
FLOW REACTOR KINETICS OF ETHYLENE HYDROGENATION OVER METAL OXIDE CATALYSTS
Roland Ru-kwei Kyi (Ph.D. Thesis) 1966 93 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-16032

The kinetics of ethylene hydrogenation over metal oxide catalysts, TiO_2, Cr_2O_3, Fe_2O_3 and ZnO, were investigated in a flow reactor, at temperatures between 90°C and 475°C and a total pressure of 1 atmosphere. The activation energy and the reaction order were determined using helium as a diluent. The rate of hydrogenation to ethane was found to be less than first-order in ethylene partial pressure over all the catalysts and first-order in hydrogen partial pressure over TiO_2, Cr_2O_3 and Fe_2O_3 but second-order in hydrogen partial pressure over ZnO. The apparent activation energy was found to be 22 kcal/mol. for TiO_2 around 400°C, 19 kcal/mol. for Cr_2O_3 around 250°C, 23 kcal/mol. for Fe_2O_3 around 100°C and 62 kcal/mol for ZnO around 320°C, which changed to 34 kcal/mol. at temperatures above about 360°C. Dissert. Abstr.

N68-35061 Columbia Univ., New York.
EFFECT OF X-RADIATION UPON THE ELECTROPHORETIC MOBILITY OF SILVER IODIDE COLLOIDS
Mark Andrew Spivack (Ph.D. Thesis) 1966 76 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-16045

The change in the electrophoretic mobility of negative silver iodide sols was studied as a function of dose of 50 Kev X rays. The change in mobility almost directly reflects the growth and decay of iodine in an iodide solution, the change being caused by the preferential adsorption of iodine over iodide at the particle. Contrary to previous findings, results indicate that iodine is formed, at low doses, in dilute (less than 10^{-3}M) de-aerated potassium iodide solutions; however, further irradiation reduces it back to iodide by radiation produced hydrogen. Dissert. Abstr.

N68-35062 Michigan Univ., Ann Arbor.
VAPOR LIQUID EQUILIBRIUM BEHAVIOR IN METHANE HYDROCARBON SYSTEMS
Nicholas Walter Prodany (Ph.D. Thesis) 1967 186 p
Available from Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 67-15677

Methane–pentane binary and ternary systems were studied throughout the two-phase region. Phase equilibrium was obtained in a constant-volume cell equipped with an internal stirrer. Phase compositions were determined by withdrawing small samples of each phase and analyzing them using gas chromatography. Vapor–liquid equilibrium data were obtained for the methane-isopentane binary system at pressures from about 500 psia up to the critical region at temperatures of 160°F, 220°F and 280°F. Data were obtained for the methane–neopentane binary system for pressures from about 300 psia up to the critical region at temperatures of 160°F, 220°F, and 280°F. Data were obtained for the methane-normal pentane binary system at a temperature of 220°F. The phase behavior of the methane–isopentane–normal pentane ternary system was investigated. Vapor and liquid phase compositions were determined at pressures from about 500 psia up to the critical region at temperatures of 160°F, 220°F, and 280°F. Finally data were obtained for the methane-neopentane-normal pentane ternary system at pressures from 500 psia up to the critical region at a temperature of 160°F. Dissert. Abstr.

N68-35075# Yale Univ., New Haven, Conn. Sterling Chemistry Lab.
PRESSURE DEPENDENCE OF ELECTROLYTIC CONDUCTANCE Final Report, 1 Jan.–30 Jun. 1968
Raymond M. Fuoss Jul. 1968 5 p
(Grants AF-AFOSR-244-63; AF-AFOSR-244-65)
(AFOSR-68-1617; AD-672277)

Conductances as a function of pressure at 30C were measured for the following systems: tetra-iso-amylammonium picrate in diethyl ether, benzene and anisole; sodium bromide, tetramethyl ammonium bromide,tetrabutyl ammonium bromide and tetrabutyl ammonium tetraphenylboride in methanol and in ethanol. The pressure range extended to 5000 atmospheres (except for benzene, which freezes under a pressure of about 750 atmospheres). Densities and dielectric constants under pressure were measured for toluene, o-xylene, p-xylene, cumene, diethyl ether, di-n-propyl ether, anisole, n-butyl chloride, chlorobenzene, 1,1-dichlorethane, 1,2-dichloroethane, and 1,2-dibromoethane. Viscosities under pressure were measured for n-propyl ether, diethyl ether, isopropenol, cumene, n-butyl chloride and 1,2-dichloroethane. Apparatus and methods for measuring conductance, dielectric constant, density and viscosity under high pressure are described. Author (TAB)

N68-35092 Northwestern Univ., Evanston, Ill.
KINETICS AND MECHANISMS OF THE REDUCTION OF SOME PLATINUM (4) COMPLEXES BY CHROMIUM (2)
James Kenneth Beattie (Ph.D. Thesis) 1967 147 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-15187

The oxidation-reduction reactions of some complexes of platinum (IV) with chromium(II) were investigated. Both $[Cr(bipy)_3]^{2+}$ and Cr^{2+} were used as reducing agents. In those cases for which a stoichiometry was established two moles of chromium(II) are oxidized to chromium(III) for each mole of platinum(IV) reduced to platinum(II). For most of the platinum(IV) complexes reduced with $[Cr(bipy)_3]^{2+}$, kinetic experiments led to a second-order rate law, first-order in platinum(IV) and first-order in chromium(II). Reduction of $[Pt(NH_3)_5OH]^{3+}$ and trans-$[Pt(en)_2(OH)_2]^{2+}$ displayed more complicated rate expressions. This order is similar to that found for the analogous reduction of cobalt(III) complexes by $[Cr(bipy)_3]^{2+}$, except that hydroxo-platinum(IV) complexes are reduced particularly slowly. The relative order of rates of reduction also parallels the half-wave potentials for the reduction of platinum(IV) complexes at the dropping-mercury electrode. Dissert. Abstr.

N68-35094# Bureau of Mines, Reno, Nev.
RECOVERY OF SULFUR FROM MOLYBDENITE
F. P. Haver, K. Uchida, and M. M. Wong Oct. 1968 19 p refs
(BM-RI-7185)

The Bureau of Mines developed a process to extract about 90 percent of the sulfur from molybdenite flotation concentrate by compacting the concentrate with one-quarter of its weight of aluminum powder, heating it at 800°C for 30 minutes, and then allowing the product to react with water. This thermite reduction yields an impure molybdenum alloy plus aluminum sulfide. The latter readily hydrolyzes, to yield pure hydrogen sulfide which can be converted to elemental sulfur by the Claus process. At least 95 percent of the molybdenum can be subsequently recovered as 99.95-percent-pure molybdic oxide. Author

N68-35142 Texas A&M Univ., College Station.
MOLECULAR FORCE FIELDS AND THERMODYNAMIC PROPERTIES OF ELECTRONICALLY EXCITED TRIATOMIC AND TETRAATOMIC MOLECULES
Shanti Arvind Kudchadker (Ph.D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 67-16462

During the past few years, a sufficient number of detailed spectroscopic measurements have been carried out on the rotational and the vibrational states of triatomic and tetraatomic excited species so that calculations of their thermodynamic properties with the methods of statistical mechanics can now be carried out. Cetrain simple polyatomic molecules, such as H_2O, D_2O, ClO_2, SO^{16}_2, XO^{18}_2, NO_2, CH_2O, CD_2O, and CHDO for which electronic spectra are thoroughly studied and satisfactorily analysed, were selected for this study to carry out statistical calculations of the thermodynamic properties. To predict the unobserved fundamental frequencies and molecular force fields, a normal coordinate analyses were carried out using the most general quadratic potential function of the valence force type. Dissert. Abstr.

N68-35168 Northwestern Univ., Evanston, Ill.
THEORETICAL OF THERMAL REACTIONS IN THE GAS PHASE
William George Valance (Ph.D. Thesis) 1967 240 p
Available from Univ. Microfilms: HC $10.80/Microfilm $3.00 Order No. 67-15354

Solving the appropriate kinetic equations, general rate constants for gas phase unimolecular reactions, diatomic molecule dissociations and three body recombinations have been derived as exact consequences of the probabilities for collisional energy transfer and reaction in the kinetic equation. Efficient methods for

computing these rate constants from any set of probabilities are given. It is shown that a matrix formulation of the kinetic equations and their solutions provides a useful microscopic theory for gas phase kinetics. Two immediate problems suggest themselves as a result of such a theory: (1) More accurate experiments directed to obtain microscopic information on collisional energy transfer are needed. (2) More accurate theoretical treatments of the collisional transition probabilities are needed. Dissert. Abstr.

N68-35169 Minnesota Univ., Minneapolis.
STUDIES IN MOLECULAR ELECTRONIC STRUCTURE
Thomas David Bouman (Ph.D. Thesis) 1967 263 p
Available from Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 67-14598

Semi-empirical quantum-mechanical calculations are performed on three different classes of organic molecules in an attempt to better understand the origin of certain empirical rules for the prediction of molecular properties in each of the three classes. In some instances, the methods used are found to be not fully adequate to account for experimental results. A rule given by Mislow, which relates the angle between two tetrahedral hybrid carbon orbitals (θ_0) to the corresponding C-C-C internuclear angle (θ_n) in cycloalkanes, is treated by the method of maximum overlap orbitals. Woodward's Rules for predicting UV absorption maxima in alkylated conjugated dienes and enones are also analyzed. A theoretical method is developed for treating the Octant Rule of Moffitt, et.al. for the optical activity of saturated ketones. An extensive Appendix presents a number of FORTRAN computer programs which are useful in semi-empirical molecular structure calculations. These include: a semi-empirical atomic integrals program, a SCF-MO program, a configuration-interaction program, a coupled chromophore program, and an optical activity program for saturated ketones. Listings and detailed instructions for use are included. Dissert. Abstr.

N68-35184# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
ON THE TEMPERATURE DEPENDENCE OF THE HEAT OF FORMATION OF THE COMPOUND AGMG
A. K. Jena and M. B. Bever Jul. 1968 10 p refs
(Contract Nonr-3963(19))
(TR-7; AD-673044)

Heats of formation at 78K, 195K and 273K of the compound AgMg containing 50.1 at. pct Mg were measured by metal solution calorimetry. The relative partial gram-atomic enthalpy of silver in liquid tin-rich solutions at infinite dilution was also measured. The temperature coefficient of the heat of formation is negative and appreciable near 78K, but with increasing temperature it decreases gradually to a small value near room temperature. This is consistent with the reported high-temperature heat contents of AgMg, Ag and Mg. It is suggested that such behavior of the temperature dependence of the heat of formation can be explained on the basis of the contributions from lattice heat capacities. Author (TAB)

N68-35187 Cornell Univ., Ithaca, N. Y.
THE HETEROGENEOUS SYNTHESIS OF AMMONIA IN THE PRESENCE OF GAMMA RADIATION
James Langley Snyder (Ph.D. Thesis) 1967 198 p
Available from Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 67-16370

The effect of cobalt-60 gamma radiation upon the synthesis of ammonia in the presence of two types of solids was investigated. The solids were a typical commercial synthesis catalyst and several commercial aluminas. Preliminary experiments using stoichiometric gas mixtures showed that the rate in the homogeneous system was 8.6×10^{-8} moles ammonia/l. hr at 250 psig, 25°C, and a dose rate of 1.8×10^6 rads/hr. Experiments at 750 and 1000 psig, and 6.5×10^5 rads/hr showed that the gamma radiation had no effect upon the reaction over the commercial synthesis catalyst, a triply promoted magnetite that had been reduced. Conversely, experiments with alumina showed a definite beneficial effect. Although no ammonia was produced in the absence of radiation, or by pre-irradiation of the alumina, concurrent irradiation of 6.4×10^5 rads/hr produced synthesis rates up to 100 times the corresponding rates in the homogeneous system. A maximum rate limitation which was a function of the temperature, pressure, alumina specific surface area and gas composition was encountered. The same rate limitation was encountered in experiments with the 210 meters^2/gram alumina and a 3:1 nitrogen to hydrogen mixture, although at the lower temperatures and pressures the pressure dependence shifted to one-half and the activation energy decreased to 6 to 7 Kcal/mole. These results are explained in terms of an energy transfer mechanism involving the alumina and the nitrogen and hydrogen molecules chemisorbed on its surface. The maximum rate limitation and the results of the experiments with the magnetite catalyst are explained by this mechanism. Dissert. Abstr.

N68-35215# Colorado Univ., Boulder.
A CONSTANT PRESSURE GAS ABSORPTION REACTOR
M. B. Kennedy and J. R. Lacher [1968] 8 p
(Grant NSF GP-5406)

A gas absorption reactor is described that can be used to study the rate of uptake of gases for gas-liquid reactions at constant pressures between 20 and 30°C. It can also be used to determine the volume of gas absorbed per unit volume of liquid at atmospheric pressure. The reactor enables charging the liquid sample holder and introducing liquid to the reaction bulb. It also has a modification to permit the use of air-sensitive liquids, and a sampling device for withdrawing liquid or gas samples from the reaction flask. Details of reactor construction are included. M.W.R.

N68-35216# Florida Univ., Gainesville.
EXCITED STATES OF LITHIUM HYDRIDE
Robert Michael Predny (M.S. Thesis) 1968 69 p refs

Atomic calculations were performed on low lying states of beryllium and lithium to obtain atomic Slater-type orbitals (STO) basis functions for the study of some excited states of lithium hydride. A configuration interaction wave function was used to optimize the energy of a state with respect to variation of the orbital exponents of its STO functions; and energies of 99.6% or more of the experimental value were obtained. The lowest $^3\Sigma$ state of LiH was found to be repulsive, and a potential energy curve was about 0.015 au lower than a previous result. It is suggested that the molecular calculations might be improved by optimizing the energy at each internuclear separation with respect to some of the orbital exponents of the hydrogen STO's. Only single non-orthogonalized STO's were used, with basis functions that are a linear combination of atomic orbitals avoided for computational ease. M.W.R.

N68-35285# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GAS CHROMATOGRAPHIC ANALYSIS OF MIXTURES OF HYDROGEN, CARBON MONOXIDE, AND METHANE [ANALIZ SMESI VODORODA, OKISI UGLERODA I METANA KHROMATOGRAFICHESKIM METODOM]
A. A. Shutov and I. P. Kirillov 29 Aug. 1967 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Khim. i Khim. Tekhnol. (Moscow), v. 7, no. 4, 1964 p 688-690
(FTD-HT-67-176; AD-672685)

Conditions are given under which H-CO-CH4 mixtures may cleanly separate in five minutes. TAB

N68-35286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEPENDENCE OF OPTICAL ANISOTROPY OF MACROMOLECULES ON THE PROPERTIES OF A SOLVENT

[ZAVISIMOST'OPTICHESKOY ANTIZOTROPII MAKROMOLEKUL OT SVOYSTV RASTVORITELVA]

E. V. Frisman, A. K. Dadivanyan, G. A. Dyuzhev, and Yu. G. Kamenev 29 Sep. 1967 12 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 9, no. 5, 1964 p 521–526
(FTD-MT-24-212-67; AD-672689)

The segmental anisotropy (alpha1 - alpha2) of polyvinyl butyrate (I), polyvinyl propionate (II), polyvinyl butyral (III), and polychloroprene (IV) was calculated on the basis of dynamic birefringence and viscosity determined at 21C on solutions of I–IV in solvents with a value of n approximately equal to that of the polymer. Both aromatic and nonaromatic solvents were used. The experimental results are explained by assuming that an anisotropy increment due to orientation of molecules of the solvent with respect to segments of the polymer chain is added to the true segmental anisotropy of the polymer. TAB

N68-35302# TRW Systems, Redondo Beach, Calif. Chemical Sciences Dept.

FLUORESCENCE AND PHOSPHORESCENCE OF AROMATIC HYDROCARBONS IN POLY(METHYLMETHACRYLATE) AS A FUNCTION OF TEMPERATURE

John L. Kropp and William R. Dawson 1968 16 p refs
(Contract N00014-67-C-0327)
(TRW-07126-6004-R-000; AD-672849)

Fluorescence lifetimes (t) and fluorescence yields(P) of poly(methylmethacrylate) samples containing coronene-h12, coronene-d12, pyrene-h10, pyrene-d10, 1,2;5,6 dibenzanthracene, 1,2;7,8 dibenzanthracene, 1,2;3,4 dibenzanthracene, 1,2 benzcoronene and 1,12 benzperylene were measured. For all compounds studied, except coronene-h12 and coronene-d12, t decreases with increasing temperature. For all compounds except 1,12 benzperylene and 1,2;3,4 dibenzanthracene, P decreases proportionally with t so that the radiative lifetime (t) is temperature independent. For the two last mentioned compounds t varies with temperature. This may be due to the closeness of the p band to the lowest-lying alpha band. The activation energies of temperature dependent quenching of t are all similar. The quenching is related to Lins theory of radiationless transitions and it is suggested that this temperature dependant quenching is due to S1 -- So transitions. Author (TAB)

N68-35307 National Lending Library for Science and Technology, Boston Spa (England).

INVESTIGATION OF COMPLEX FORMATION IN THE SYSTEM V(IV)–TIRON [ISSLEDOVANIE KOMPLEKSOOBRAZOVANIYA V SISTEME V(IV)–TIRON]

I. A. Tserkovnitskaya and M. F. Grigor'eva Sep. 1968 10 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), v. 21, no. 16, 1966 p 130–134
(RTS-4791) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

Preliminary studies indicated that in the pH range from 1 to 8 the formation of the complex vanadium (IV) with tiron did not take place; and for alkaline solutions maximum light absorption occurred at pH 11. Studies using an ammonium chloride buffer solution exhibited sufficient stability for investigations by spectrophotometric and amperometric methods; sensitivity for the former was 5×10^{-5} mole/liter, for the latter 5×10^{-7} mole/liter. The saturation curve was traced at a constant concentration of V(IV) = 4×10^{-4} mole/liter, with an increasing concentration of tiron; and a molar extinction coefficient for $\lambda = 410\ \mu$ of 2.5×10^3. Polaragraphic behavior of V(IV) was measured on a dropping mercury cathode; and at pH 11 the polaragraphic wave with $E_{1/2} = 1.41$V, tiron was not reduced, and the complex V(IV) with tiron was reduced to $E_{1/2} = -0.64$V. M.W.R.

N68-35345# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF CYCLES OF INCREASED PRESSURE FOR PRODUCTION OF LIQUID OXYGEN [ISSLEDOVANIE TSIKLOV POVYSHENNOGO DAVLENIYA DLYA POLUCHENIYA ZHIDKOGO KISLORODA]

A. G. Golovintsov, A. M. Arkharov, and M. B. Stolper 17 Nov. 1967 15 p ref Transl. into ENGLISH from Khim. i Neft. Mashinostr. (Moscow), no. 4, 1961 p 15–19
(FTD-HT-23-1376-67; AD-672904)

Data are presented from an analysis of possible energy parameters and design principles of high-pressure cycle instillations for the separation of liquid oxygen from air. TAB

N68-35347# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEW METHODS OF DETERMINATION OF PHOSPHORUS

A. A. Fedorov 11 Aug. 1967 180 p refs Transl. into ENGLISH from "Novyye Metody Opredeleniya Fosfora" Moscow, Izd. Met., 1965 p 1–173
(FTD-MT-66-160; AD-673192)

Descriptions are given of new chemical and physico chemical methods of determination of phosphorous in base materials of the metallurgical industry. Certain source materials are examined critically. As a result of application of new methods it was found that in certificates of a number of standard samples erroneous determinations of phosphorous have occurred. TAB

N68-35366# Western Electric Co., Inc., New York.

EFFECTS OF RADIATION ON SEMICONDUCTOR MATERIALS AND DEVICES Final Report, 1 Jan.–31 Dec. 1967

D. K. Wilson, J. P. Mitchell, J. D. Cuthbert, and H. S. Lee Apr. 1968 190 p refs
(Contract F19628-67-C-0147)
(AFCRL-68-0250; AD-672812)

Results of investigation on the effects of nuclear radiation on semiconductor materials, device surface layers, and devices are discussed. Author (TAB)

N68-35377# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT OF FORMATION OF SILICON CARBIDE AND PRODUCTS OF ITS EVAPORATION [TEPLOTA OBRAZOVANIYA KARBIDA KREMINYA I PRODUKTOV EGO ISPARENIYA]

N. I. Voronin, N. L. Makarov, and B. F. Yudin 13 Oct. 1967 12 p refs Transl. into ENGLISH from Issled. Obl. Khim. Silikatov Okislov (Moscow), 1965 p 203–208
(FTD-MT-24-245-67; AD-672698)

The study was undertaken in order to determine the heats of formation of SiC and products of its vaporization from vapor pressure data. Langmuirs method was used to determine the total vapor pressure over SiC and partial pressures of Si, Si2C and SiC2 at temperatures of 2113, 2193 and 2273K. TAB

N68-35384# Oregon Univ., Eugene. Dept. of Chemistry.

NOVEL STRUCTURES AS PRECURSORS FOR ORGANIC IONS OF UNUSUAL STABILITY Final Technical Report, 1 Oct. 1964–31 Mar. 1968

Virgil C. Boekelheide Mar. 1968 53 p refs
(Contract NONr-2771(07))
(AD-672931)

Various synthetic approaches to preparing novel aromatic molecules containing a positively charged atom within the cavity of the pi-cloud have been explored. A method of synthesizing the

previously unknown (2.2) metacyclophane-1-enes was devised. These molecules exhibit an interesting, and reversible, photoisomerization. Also, such (2.2) metacyclophane-1-enes undergo dehydrogenation and provide a new route to trans-15, 16-dialkyldihydropyrenes. Author (TAB)

N68-35402# Cincinnati Univ., Ohio.
THE CONDENSATION COEFFICIENT OF NIO
M. Hoch and D. Ramakrishnan Wright-Patterson AFB, Ohio AF Mater. Lab. Mar. 1968 47 p refs
(Contract AF 33(615)-3420)
(AFML-TR-68-60; AD-672835)

The condensation coefficient of oxygen in NiO was studied using the isotope exchange technique applied earlier for aluminum nitride and boron nitride. Experiments were carried out in a platinum Knudsen cell and in an aluminum oxide Knudsen cell. Using the aluminum oxide Knudsen cell, the condensation coefficient beta for NiO was found to be 0.11 in the temperature range 1700-1750K. Using the platinum Knudsen cell, the exchange coefficient reached an equilibrium value of 0.5 because oxygen exchange also took place on the hot platinum surface. It was found also that NiO exchanges with oxygen in the air very slowly at room temperature. Author (TAB)

N68-35403# California Univ., Santa Barbara.
FLUORESCENCE LIFETIMES OF AROMATIC HYDROCARBONS UNDER PRESSURE
Henry W. Offen and David T. Phillips 1 Aug. 1968 13 p refs
(Contract N00014-67-A-0120)
(TR-13; AD-672830)

The fluorescence lifetimes of twelve aromatic hydrocarbons embedded in polymethylmethacrylate were measured as a function of pressure to 30 kbar. The lifetime is shortened 15-40% in the 0-30 kbar interval for this class of compounds. The observed magnitude and sign of the pressure dependence of the lifetimes are in agreement with rough estimates derived from the compressibility and refractive index of the polymer matrix. The conclusion is reached that radiative and nonradiative transition rates are similarly (within a factor of two) affected by external pressures. Author (TAB)

N68-35410# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHOTOCHEMICAL CONVERSION OF COLOR CENTERS IN HEATED CRYSTALS OF POTASSIUM CHLORIDE [O FOTOKHIMICHESKOM PREVRASHCHENII KRASYASHCHIKH TSENTROV V NAGRETYKH KRISTALLAKH KHLORISTOGO KALIYA]
A. A. Shatalov 19 Oct. 1967 16 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 29, no. 6, 1955 p 847-856
(FTD-MT-24-217-67; AD-672692)

Exposition of the results of an investigation into the photochemical conversion of F-centers in KCl crystals at temperatures 270-300C, which leads to the complete disappearance of the F-band of absorption and to its substitution by a very similar new symmetric bell-shaped band (X-band) displaced about 0.5 ev toward the long-wavelength side. For lower temperatures (250-150C) the light action also leads to complete disruption of the F-band with its substitution by wider and lower symmetrical bands of absorption displaced somewhat still more toward the side of long wavelengths. The temperature dependence of the absorption X-band is characterized by its enhancement, contraction, and insignificant displacement toward the short-wavelength side during cooling. The author presents preliminary results of the measurement of the kinetics governing the process of photochemical conversion of F-centers for various temperatures, and expresses an assumption concerning the connection between observed thermophotochemical conversions of F-centers and the process of formation of colloids of the alkali metal. He states the possible mechanism governing the conversion of F-centers into F2-centers under the action of light. Author (TAB)

N68-35413# Monsanto Research Corp., Dayton, Ohio.
INVESTIGATION OF HIGH-TEMPERATURE GAS CHROMATOGRAPHY SUBSTRATES Annual Report, 30 Sep. 1966-30 Sep. 1967
William D. Ross Apr. 1968 64 p refs
(Contract AF 33(615)-1176)
(ARL-68-0066; AD-672980)

An assay for the analysis of iron in Mesabi iron ore has been developed by the reaction of the iron with the chelating compound, 1, 1, 1, 2, 2, 3, 3-heptafluoro-7, 7-dimethyl-4, 6-octanedione (H(fod)), with subsequent analysis of the volatile metal chelate by gas chromatography. Several metal chelates were synthesized by the direct reaction of the metal or metal compound with a chelating compound. Most of the rare earth metals were found to react directly with H(fod) in microreactor capsules. Investigations were initiated to determine if the interstitial gases in metals can be identified and measured by gas chromatography. The metal and the chelating compound are sealed in a glass capillary and heated. The metal is dissolved, releasing the entrapped gases in the capsule. The contents then are analyzed by gas chromatography. An investigation of the effects of radio frequency energy on the reaction rate of metals with chelating compounds was initiated. The reaction rates were compared to those obtained from heating the reactants in an oven. Author (TAB)

N68-35415# Oak Ridge National Lab., Tenn.
X-RAY DIFFRACTION DATA ON LIQUID BENZENE AT 25°C
J. A. O'Malley (Drexel Inst.), and A. H. Narten Oct. 1967 23 p refs
(Contract W-7405-eng-26)
(ORNL-4166) CFSTI: HC$3.00/MF$0.65

The scattering of X rays from the free surface of liquid benzene in equilibrium with its vapor has been measured at 25°C. The diffractometer used was specially designed for the study of liquid structure. In this report, both the raw data and the intensity and radial distribution functions derived from them are presented in tabulated form. Intramolecular distances obtained are in agreement with those derived from gas diffraction experiments. Author (NSA)

N68-35420# Frankford Arsenal, Philadelphia, Pa. Quality Assurance Directorate.
SPECTROPHOTOMETRIC DETERMINATION OF ALUMINUM IN ZIRCONIUM AND TITANIUM POWDERS
George Norwitz Jul. 1968 31 p refs
(T68-9-1; AD-673123)

A method is proposed for the determination of aluminum in zirconium and titanium powders. A sample is dissolved in a mixture of hydrofluoric, nitric, and sulfuric acids and the solution is evaporated to fumes of sulfuric acid. Water is added and an aliquot of the solution is pipetted into a plastic beaker containing hot sodium hydroxide solution. The solution is diluted to 200 ml of which 100 ml is filtered. The filtrate is neutralized to phenolphthalein with hydrochloric acid and the aluminum is determined spectrophotometrically by the use of aluminon. The following factors affecting the spectrophotometric determination of the aluminum were investigated: volume of solution during the color development, adjustment of acidity prior to addition of composite aluminon reagent, heating time in boiling water, amount of aluminum, wave length at which transmittance is measured, stability of the color, and interference of sodium sulfate, sodium chloride, zirconium, titanium, vanadium, chromium, and tin. Author (TAB)

N68-35422# Michigan State Univ., East Lansing. Dept. of Chemistry.
THE INEFFICIENCY OF TRIPLET ENERGY TRANSFER FROM KETONES TO TRIVALENT RARE EARTH IONS
Annual Report, 1 Aug. 1967–31 May 1968
Peter J. Wagner and Herbert N. Schott Jun. 1968 7 p refs
Submitted for publication
(Contract N00014-68-A-0109)
(AD-673075)

It is shown that trivalent samarium, europium, terbium, dysprosium, and erbium chlorides are only 1-2% as effective as conjugated dienes at quenching the triplet state photoelimination of para-methoxyvalerophenone and the triplet state photoreduction of benzophenone. Maximum rate constants for energy transfer from the triplet excited ketones to the rare earth ions is (10 to the 8th power)/M/sec in solvents such as methanol and aqueous acetic acid. This conclusion refutes the former common assumption that such energy transfer was diffusion-controlled. It is postulated that the tight solvation of the metal ions prevents effective overlap of donor and ionic orbitals and thus decreases the exchange interaction necessary for energy transfer. Author (TAB)

N68-35484# Purdue Univ., Lafayette, Ind. Project Squid Headquarters.
STUDY OF THE REACTION OF MAGNESIUM VAPOR AND OXYGEN AT THE SURFACE OF MGO DEPOSITS BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY
G. H. Markstein Jul. 1968 34 p refs
(Contract N00014-67-A-0226)
(SQUID-TR-CAL-95-PU; AD-672575)

A method for investigating surface reactions of metal vapors by means of atomic-absorption spectrophotometry was developed. In this technique, the beam of resonance radiation used in the absorption measurement is confined to a thin sheet parallel to the reacting plane surface, and the optical system is provided with means for varying the distance z between the radiation sheet and the surface. the reaction of magnesium vapor and oxygen was found to be first-order in magnesium concentration. In this case, a linear relationship between absorbance and distance 2 is obtained near the surface, and the ratio k/d of the rate constant and the diffusion coefficient can be determined from the slope of a plot of absorbance vs. distance without need for an absolute calibration of the absorption measurement. previously reported methods of growing magnesium oxide deposits and of measuring their rate of growth by recording of interference fringes were employed in the present work, within the accuracy of the measurements. The rate constant with respect to magnesium–vapor concentration was independent of pressure and of oxygen concentration, but decreased markedly with incressing surface temperature, the corresponding collision efficiency decreased from unity at 410K to about 0.02 at 840K. Author (TAB)

N68-35489# TRW Systems, Redondo Beach, Calif.
STUDIES OF RADIATIONLESS TRANSISTORS IN CORONENE USING NANOSECOND LASER PHOTOLYSIS AND SPECTROSCOPY
M. W. Windsor and J. R. Novak 1968 19 p refs
(Contracts AF 33(615)-5331; N00014-67-C-0327)
(TRW-05824-6009-R-000; AD-672997)

The technique of nanosecond laser photolysis and spectroscopy was used to observe absorption from both the lowest excited singlet S1 and the lowest triplet T1, of coronene. The technique employs a Q-switched ruby laser to produce both a 30 nsec pulse at 347nm for excitation plus, at the same time, a laser-induced spark which provides a background continuum for absorption spectroscopy. New transient absorption bands were observed for coronene at 520 and 380 nm and attribute these to absorption by the S1 state. The new bands locate previously unobserved higher singlet levels of g parity. These bands decay over a period of several hundred nanoseconds and are concomitantly replaced by absorption bands characteristic of the lowest triplet state, thus providing a pictoral record of the process of intersystem crossing. The T-T absorption spectrum of coronene was also obtained in epoxy plastic out to 1.14 microns using a double-beam cross-irradiation technique. New maxima in the infra-red serve to locate the energies of three low-lying excited triplet levels. Coronene intersystem crossing from higher singlet to the triplet manifold may occur. TAB

N68-35491# Michigan State Univ., East Lansing.
RAMAN SPECTRA OF XENON FLUORIDE, IRIDIUM FLUORIDE AND XENON FLUORIDE, IODINE FLUORIDE
R. E. Miller, K. L. Treuil, and G. E. Leroi Jul. 1968 19 p ref
(Contract N00014-68-A-0109-0004)
(TR-2(7); AD-672585)

In order to assign vibrational frequencies and determine the molecular structures of several newly synthesized XeF_2, IrF_5 and XeF_2, IF_5 compounds and complexes, Raman spectra were recorded on these materials using laser excitation. Before the experiments had begun, it was noted that moisture had leaked into the cells and had reacted with the samples, resulting in the formation of a black residue on the exposed surface. Although the samples had these deposits, Raman spectra could be recorded, and several internal and external vibrational frequencies were observed. A time study on the 2:1 adduct of XeF_2, IrF_5 indicated that decomposition had taken place under the focussed 6328A He–Ne laser light, yielding peaks which were coincident with the 1:1 bands. Author (TAB)

N68-35501# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Raketentreibstoffe.
INVESTIGATION OF BAND SYSTEMS OF THE FLUORINE MOLECULE IN THE VISIBLE REGION [UNTERSUCHUNGEN DER BANDENSYSTEME DES F_2 MOLEKUELS IM SICHTBAREN]
Winfried Stricker Aug. 1968 31 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-48; DVL-769) CFSTI: HC $3.00/MF $0.65

Emission bands of the F_2 molecule are photographed in the region 4800 to 6500 Å by means of a 5 m Ebert-spectrograph with high dispersion. A glow discharge is used for intensive excitation. Experimental details of fluorine spectroscopy are discussed. It is possible to carry out a complete rotational analysis for four bands. As a result two band systems are identified, the lower state being common. The potential energy curves of all known electronic states of F_2 are drawn into consideration using results of the F_2 absorption spectrum in the extreme vacuum ultraviolet. An approximate value for the energetic distance of the ground state and the excited state is given. Author

N68-35506# Oak Ridge National Lab., Tenn.
FREE RADICALS FORMED BY THE IRRADIATION OF HIGH POLYMERS AND THEIR TRANSFORMATIONS
Hisashi Ueda, Shoji Shida, and Zenichiro Kuri [1967] 5 p refs Transl. into ENGLISH from Shinku Kagaku (Japan), v. 15, no. 1, 1967 p 3–4
(ORNL-TR-1969) CFSTI: HC $3.00/MF $0.65

Transformations of free radicals in high polymers were observed through their reactions with various gases. The behavior of these free radicals was interpreted by the physical and chemical properties of individual high polymers. High polymers were classified into 5 groups according to the transformation processes of the free radicals formed in them. Author (NSA)

N68-35518 National Lending Library for Science and Technology, Boston Spa (England).
STABILITY OF MACROMOLECULES. 19: STABILISATION OF PVC
W. Reichardt Feb. 1968 16 p refs Transl. into ENGLISH from Plaste Kautschuk (Ger), v. 14, no. 2, Feb. 1967 p 79–82
(TRANS-1526) Available from Natl. Lending Library, Boston Spa, Engl. $27.00 or 11 £

The heat degradation of PVC is reviewed, particular attention being paid to the effect of oxygen and to the lubricating effect of plasticisers and lubricants on stability. The working mechanisms of some stabiliser types are also discussed and it is described how they simultaneously affect degradation in different ways. Problems of light stabilisation are also referred to. Author

N68-35543# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
METHODS FOR THE EXAMINATION OF EXHAUSTED ION EXCHANGE RESINS FROM THE REACTOR HIFAR
H. F. Ryan Mar. 1968 16 p refs
(AAEC/M-83)

Analytical methods for examination of exhausted mixed-bed ion-exchange resins used to purify the primary circuit of the reactor HIFAR are listed and discussed. Development work on methods for separating the mixed bed into its anion and cation resin components using chloroform/acetone mixtures is reported in detail, together with methods for determining strong and weak base capacities of the anion resin. Author (NSA)

N68-35552# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ROUTINE ISOTOPIC ANALYSIS U-235 BY EMISSION SPECTROMETRY. 1: INTERFEROMETRY USING ELECTRODELESS DISCHARGE LAMPS [CONTRIBUTION A L'ANALYSE ISOTOPIQUE DE ROUTINE DE L'URANIUM 235 PAR SPECTROMETRIE D'EMISSION. 1: INTERFEROMETRIE AVEC DES LAMPES A DECHARGE SANS ELECTRODE]
Robert Capitini, Maurice Ceccaldi, and Jean-Pierre Leicknam Feb. 1968 67 p refs In FRENCH
(CEA-R-3457)

A HYPEAC interferometric apparatus was used for routine determination of ^{235}U, in order to facilitate the examination of the nonmetallic samples and to reduce the time required for analysis it was necessary to replace the hollow-cathode light sources usually used by electrodeless discharge lamps. The preparation outside the apparatus of such lamps containing uranium tetrachloride is described; the process is simple and rapid: about 90 minutes for each, and several lamps can be built simultaneously, thus reducing still further the total time required for each analysis. The amount of sample required is a few milligrams. In order to counteract any spontaneous optical disadjustment, which could prevent the application of the usual isotopic abundance method, it is necessary to compare the sample spectra with those of standards. All the spectra are recorded successively and alternately. A series of examples of determinations involving over 150 measurements is presented and discussed. For samples with abundances similar to that of natural uranium and up to 5% of the 235 isotope, the reproducibility is of the order of 2%. The relative accuracy is ±2% to 3%. For samples enriched in ^{235}U (5% to 93%) the relative accuracy can attain ±0.5%. Author (NSA)

N68-35553# Commissariat a l'Energie Atomique, Pierrelatte (France). Service Central de Documentation.
ISOTOPIC ANALYSIS OF UF-6 HEXAFLUORIDE HIGHLY ENRICHED IN U-235 [ANALYSE ISOTOPIQUE DE L'HEXAFLUORURE D'URANIUM FORTEMENT ENRICHI EN U-235]
Louis Chaussy and Robert Boyer Mar. 1968 51 p refs In FRENCH
(CEA-R-3337; Rept.-67/06)

Isotopic analysis of uranium in the form of the hexafluoride by mass spectrometry gives gross results that are not very accurate. Using a linear interpolation method applied to two standards it is possible to correct for this inaccuracy as long as the isotopic concentrations are less than about 10% in ^{235}U. Above this level, the interpolation formula overestimates the results, especially if the enrichment of the analyzed samples is higher than 1.3 with respect to the standards. A formula is proposed for correcting the interpolation equation and for extending its field of application to high enrichment values and to high concentrations. By using this correction the results have an accuracy that depends on that of the standards, taking into account the dispersion in the measurements. Author (NSA)

N68-35559 National Lending Library for Science and Technology, Boston Spa (England).
REACTION OF EPOXIDES WITH RESIDUES OF ZIEGLER–NATTA CATALYST IN POLYPROPYLENE
J. Kresta, L. Ambroz, and K. Obrucova Nov. 1967 15 p refs Transl. into ENGLISH from Chem. Prumysl (Prague), v. 17/42, 1967 p 25–30
(TRANS-1508) Available from Natl. Lending Library, Boston Spa, Engl. $25.00 or 10 £

The authors investigated the effect of epoxides on the stability and colour of the polymer and compared the results against model reactions of epoxides with individual components of Ziegler–Natta catalyst. The oxidative stability of the products of reaction of epoxides with $TiCl_3$ was examined. Author

N68-35606# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
TRANSIENT ANALYSIS FOR EXPLOSIVE PERTURBATIONS IN THE VENTILATION SYSTEM OF EUREX REPROCESSING PLANT
M. Perinetti and C. Zeffiro 1968 57 p
(RT/PROT(68)8) CFSTI: HC $3.00/MF $0.65

Transient phenomena occurring along the ventilation system of EUREX reprocessing plant after an explosion in a process cell, have been considered in this report. Fundamental equations which describe the behaviour of the plant during transient conditions have been presented and a mathematical approach to solve them with the help of an analog computer has been developed so that pessimistic results are obtained. Several analog runs were investigated and results have been reported and discussed. The structural integrity of high efficiency particulate filters has been evaluated when considering the effects of abnormal conditions caused by explosions. An appendix has been included in the report to provide information on the analog circuit. Author

N68-35618*# Brown Engineering Co., Inc., Huntsville, Ala. Thermal Measurement Section.
EVALUATION OF ANALYTICAL STANDARDS BY DIFFERENTIAL THERMAL ANALYSIS AND DIFFERENTIAL SCANNING CALORIMETRY
J. P. Evans and K. G. Scrogham 29 Apr. 1968 68 p refs
(Contract NAS8-20073)
(NASA-CR-61240) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Differential thermal analyses were run on copper sulfate pentahydrate, calcium oxalate monohydrate, potassium nitrate, and silver nitrate. Thermograms are included for each of the analyses. Differential scanning calorimetry runs were also made on the copper, potassium, and silver salts. Heats of inversion and fusion were determined for potassium nitrate and silver nitrate, and comparisons are made between experimental and literature values. Author

N68-35651# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
STUDY OF CIS- AND TRANS-URANIUM ELEMENTS BY PAPER CHROMATOGRAPHY AND ELECTROPHORESIS [CONTRIBUTION A L'ETUDE DES ELEMENTS CIS- ET TRANS-URANIENS PAR CHROMATOGRAPHIE SUR PAPIER ET ELECTROPHORESE]
Frank Clanet (Ph.D. Thesis) 1968 131 p refs In FRENCH
(CEA-R-3411)

Application of paper chromatography and electrophoresis in inorganic chemistry was extended to elements 90 to 96 in hydrochloric and nitric acid solution. Results were obtained concerning the following points: (1) Characterization of the valency states of Np and of Pu using colored reactions on chromatograms and electropherograms. The valency IV was characterized by alizarin, arsenazo-I and thorin-I, but diphenylcarbazide was used for the hexavalent state. (2) Paper chromatography: by using as eluents, mixtures of equal parts of aqueous HCl and HNO_3 solutions and of alcohols (methanol, ethanol, and butanol), the R_f values were determined. (3) An electrophoretic technique on cellulose acetate membranes was developed in order to separate the charged species formed in HCl and HNO_3 solutions from 1 to 12 M. Mobility curves were obtained. It appears that the tendency to form anionic complexes follows the order of the ionic potentials when the valency state is four; this order is reversed for the valency three. (4) Various analytical applications are considered. Author (NSA)

N68-35682# Battelle-Northwest, Richland, Wash. Applied Chemistry Sec.
DISSOLUTION OF OXIDE-COATED ZIRCONIUM AND ZIRCONIUM ALLOYS
John F. Phillips, Jr. Apr. 1968 17 p refs
(BNWL-600) CFSTI: HC$3.00/MF$0.65

Pitting or pinholing of oxide coated Zircaloy 2 coupons was markedly more rapid and extensive when the coupons were exposed to boiling 7.5 to 8M NH_4F–0.5M NH_4NO_3 than in similar exposure to the standard Zirflex dissolvent, 5.5M NH_4F–0.5M NH_4NO_3. Attack by the more concentrated dissolvent was more uniform over the surface of the metal. There are several advantages of the more concentrated reagent over the standard Zirflex reagent. Oxide coated Zircaloy 2 is more rapidly and extensively pitted. Terminal zirconium concentration in the decladding solution can be reached more quickly. Higher terminal zirconium concentrations are possible. Author (NSA)

N68-35683# California Univ., Berkeley. Lawrence Radiation Lab.
FAR-INFRARED SPECTRA OF Al_2O_3 DOPED WITH Ti, V, AND Cr
R. R. Joyce and P. L. Richards Jun. 1968 24 p refs
(Contract W-7405-ENG-48)
(UCRL-18229) CFSTI: HC$3.00/MF$0.65

The absorption spectrum of samples of Al_2O_3 doped with Ti, V, and Cr was measured at 4.2°K over the frequency range from 5 to 120 cm^{-1}, in applied magnetic fields up to 55 kOe. In Al_2O_3:Ti absorption lines were observed at 37.8 cm^{-1} and 107 cm^{-1}; these were due to transitions between the ground and first excited states of the Ti^{3+} ion in a modified Al_2O_3 crystalline field. Similar results were observed from the isoelectronic V^{4+} ion in the Al_2O_3:V sample. Zero field absorption lines were observed at 28.1 cm^{-1} and 53 cm^{-1}, with g-values for the ground and first excited states. The predicted energy levels of a single d electron in the Al_2O_3 crystalline field modified by a dynamic Jahn–Teller effect fit these data quite well. An absorption line observed at 8.25 cm^{-1} Al_2O_3:V was attributed to the spin orbit splitting of the lowest electronic state of the V^{3+} ion. A 15-cm length of 1% Al_2O_3Cr showed no absorption lines for any value of magnetic field. Author (NSA)

N68-35691# Los Alamos Scientific Lab., N. Mex.
INDX: A COMPUTER PROGRAM TO AID IN THE INDEXING OF X-RAY POWDER PATTERNS OF CRYSTAL STRUCTURES OF UNKNOWN SYMMETRY
R. B. Roof, Jr. Apr. 1968 36 p refs
(Contract W-7405-ENG-36)
(LA-3920) CFSTI: HC$3.00/MF$0.65

A computer program, INDX, was developed that attempts to index X-ray diffraction powder patterns by finding a reduced triclinic cell whose calculated Q values ($Q = 1/d^2$) match a desired percentage of the observed Q values within a given limit of error. If a reduced triclinic cell is found, the cell constants may be used to form a rectangular array, i.e., a Niggli matrix, and reference to published tables of general and special Niggli matrices reveals whether or not the specific triclinic cell may be transformed to a cell of higher symmetry. Author (NSA)

N68-35697# Oak Ridge National Lab., Tenn.
AN EMF STUDY OF LiF-BeF SOLUTIONS
B. F. Hitch and C. F. Baes, Jr. Jul. 1968 46 p refs
(Contract W-7405-ENG-26)
(ORNL-4257) CFSTI: HC$3.00/MF$0.65

The potential of the cell $Be^{0}|BeF_2$, LiF|HF,H_2,Pt with the assumed cell reaction, Be(s) +2HF(g)=BeF_2(d) + H_2(g), was measured over a composition range from 0.30 to 0.90 mole fraction BeF_2 and a temperature range from 500 to 900°C. Since this cell potential is related to the activity of BeF_2 in the solutions by $E = E^0 - RT/2F \ln P_{H2}{}^{a}{}_{BeF2}/P^{2}{}_{HF}$, activity coefficients could be derived for BeF_2 (and by a Gibbs–Duhem integration for LiF). Usefully accurate measurements could not be made with pure BeF_2 in the cell, hence values of E^0 were calculated using values for a $_{BeF_2}$ derived from the phase diagram and previously reported heat of fusion (1.13 kcal/mole) giving $E^0 = 2.4430 - 0.0007952T$. This comparison of the emf data with the LiF–BeF_2 phase diagram also indicated that the heat of fusion for BeF_2 is <2.0 kcal/mole. A power series was assumed and the coefficients determined by a least squares fit. Formation free energies and heats for BeF_2 and BeO were also calculated by combining the results of the present study with available thermochemical data. The $Be^{2+}|Be^0$ and Hf, $H_2|F^-$ electrodes performed acceptably for use as reference electrodes, both being stable and reproducible. Author (NSA)

N68-35708# Telefunken G.m.b.H., Ulm (West Germany).
MASKING ABILITY, IMPURITY CONTENTS AND INFRARED ABSORPTION OF SOME SiO_2 LAYERS [MASKIERWIRKUNG FREMDSTOFFGEHALT UND INFRAROTABSORPTION VERSCHIEDENER SiO_2 SCHICHTEN]
I. Fraenz and W. Langheinrich Bad Godesberg Bundesministerium Fuer Wiss. Forsch. Jul. 1968 43 p refs In GERMAN; ENGLISH Summary
(BMwF-FB-68-50) CFSTI: HC$3.00/MF$0.65

Thin layers of silicon dioxide on silicon substrates were produced by seven different deposition methods involving oxidation, pyrolysis, and hydrolysis. The ability of the layers to mask against phosphorus pentoxide was tested using tracer techniques with the P 32 isotope. Infrared absorption spectra of the oxide layers were obtained and evaluated. Author

N68-35713# Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires.
STUDY OF PROCESSES OF TREATMENT BY AQUEOUS METHOD: LABORATORY Semiannual Report, Dec. 1966–May 1967
[1967] 101 p refs
(ANL-TRANS-619) CFSTI: HC$3.00/MF$0.65

Topics covered include: influence of possible modifications in "graphite–gas" fuels on their chemical processing, oxidation and reduction of plutonium, boiling of aqueous solutions containing

tributyl phosphate, plutonium oxalate precipitation, plutonium recovery cycle, processing of highly irradiated enriched uranium oxides, extraction disturbance tests, the Rapsodie irradiated fuel reprocessing plant, and purification of plutonium by trilaurylamine extraction. NSA

N68-35725# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

CONTRIBUTION TO THE ISOTOPIC ANALYSIS OF NITROGEN USING OPTICAL SPECTROMETRY [CONTRIBUTION A L'ANALYSE ISOTOPIQUE DE L'AZOTE PAR SPECTROMETRIE OPTIQUE]

Jean-Pierre Leicknam Mar. 1968 49 p refs In FRENCH
(CEA-R-3410)

The possibility of analyzing a gaseous mixture by emission spectrometry that is poor in N^{15} (isotopic abundance less that 2 %) was investigated. The method of isotopic analysis proposed only requires a spectrometer of average resolving power; it is even possible to use a spectrograph with a slit replacing the photographic plate, and a photomultiplier; this transformation is very simple to carry out and the signals from the detector can then be received by a recorder. Under these conditions a measurement takes only from three to ten minutes, according to the accuracy required. The light sources are made up of electrode-less discharge lamps, excited by high frequency; the filling conditions are such that the lamps may be prepared in a few minutes, the impurities being sufficiently eliminated for the measurements not to be affected. The choice of the analytical band couple depends on the relative position of the isotopic bands and on the possible presence of traces of these impurities: amongst the transitions in the system $C(^3\pi_u) \rightleftarrows B(^3\pi_g)$, it is the 2–0 transition that has the most favorable position for this isotopic analysis. The method was applied to samples of varying origins (ammonium salts, fertilizer and plants): the isotopic contents were determined with an accuracy of 3% in the neighborhood of the natural abundance, and of 1% when the sample contained about 1.5 atoms of N^{15} for 100 atoms of N^{14}. The accuracy is therefore quite sufficient for most of the biological research using the mass 15 as a tracer. Author (NSA)

N68-35739# Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France).

SEMIANNUAL REPORT OF THE CHEMISTRY DEPARTMENT, CENTER FOR NUCLEAR STUDIES AT FONTENAY-AUX-ROSES, DIRECTION OF NUCLEAR MATERIALS AND FUELS, DECEMBER 1966–MAY 1967

[1967] 128 p
(CEA-N-856; ANL-TRANS-628) CFSTI: HC $3.00/MF $0.65

Several studies on the vitrification of solutions of fission products and on the preparation and analysis of actinide elements are reported. Inverse-phase chromatography with trilaurylamine (TLA) in reducing medium was investigated for the separation of Np from concentrated U solutions. The separation coefficients were determined for lanthanides and Am between the organic phase containing TLA and 40% HNO_3 in a mixture of 50% dodecane and 50% chlorobenzene and the aqueous phase with variable composition. The processing of irradiated Pu and the dissolution of Pu-Al fuel elements was studied using mixed and acid dissolutions. The determination of Pu, Ru, rare earths, Zr, free acid, and Al in solutions from the processing of irradiated Pu are described. The vitrification studies were made on various types of solutions and solid residues from dry processing methods. An induction furnace was improved for processing the solutions obtained from slightly alloyed U. Thermal and electrostatic phenomena produced during storage of active glass blocks are described. Pot vitrification and continuous calcination and vitrification were examined with solutions from processed U-Mo alloys. Vitrification of solutions from U-Al fuels was accomplished by eliminating the Hg dissolution catalyst. A direct microdetermination technique was developed for the apparent normal potential of the Ce(IV)-Ce(III) couple. K.W.

N68-35747*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TEMPERATURE DEPENDENCE OF THE RATE CONSTANTS FOR THE REACTIONS $O^+ + O_2 \rightarrow O_2^+ + O$ AND $O^+ + N_2 \rightarrow NO^+ + N$

Peter Stubbe Sep. 1968 25 p refs Supported in part by NRC
(NASA-TM-X-63342; X-615-68-138) CFSTI: HC $3.00/MF $0.65
CSCL 07D

The dependancy of the rate constant k_v for the reactions (k_1 and k_2 respectively) on the gas temperature T, the vibrational temperature T_v of the molecular reactant, and the relative flow velocity v_s between the gases, is studied theoretically by means of a collision theory approach. The resulting expression for k_v contains the two unknown parameters A (activation energy) and P_0 (scaling factor) which have to be determined empirically. The k_1 (T) is found to have a minimum at about 650° K and a nearly linear increase for temperatures above 750° K. For the second reaction, the rate constant is presented as a function of T and A, since uncertainties in the experimental results do not allow a reliable determination of A. The increase rate of k_2 with T_v (N_2), the vibrational temperature of N_2, falls off strongly with increasing gas temperature. Author

N68-35751 National Lending Library for Science and Technology, Boston Spa (England).

THE SEPARATION OF THE VALENCE CONDITION OF FERRIC ION FROM FERROUS ION ON ION EXCHANGE RESINS

A. Rusi and S. Ionescu [1968] 11 p Transl. into ENGLISH from Studii Cercetari Fiz. (Bucharest), v. 2, 1963 p 127–131
(M-7385) Available from Natl. Lending Library, Boston Spa, Engl.

Three methods are described for achieving a rapid and complete separation of ferrous ions resulting from ferric complexes subjected to neutron irradiation. In all cases, the determinations were carried out by measuring the activity of iron 59. To verify the efficacy of each method, the activity introduced on the column was measured as well as that obtained in the elutant. Author

N68-35754# Los Alamos Scientific Lab., N. Mex.

THE CHEMICAL DIFFUSION OF CARBON IN THE GROUP VI-B METAL CARBIDES

R. J. Fries, J. E. Cummings, C. G. Hoffman, and S. A. Daily 9 Apr. 1968 32 p refs Presented at the 6th Plansee Seminar on High Temp. Mater.; Fundamentals and Develop., Reutte, Austria, 24–28 Jun. 1968
(Contract W-7405-ENG-36)
(LA-3795-MS; CONF-680603-1) CFSTI: HC $3.00/MF $0.65

The chemical diffusion of carbon in tungsten, molybdenum, and chromium carbides was studied by measuring the growth rates of the carbide layers on appropriate metal samples. The rate-determining step of the diffusion process was found to be the diffusion of the carbon through the carbon phases. Grain boundary diffusion was unimportant. Tungsten carbide layer growths were studied over the range 1500 to 2535°C. Below 2400°C, only the W_2C layer growth is important, although a thin WC skin is observed. The activation energy for W_2C layer growth is observed. The activation energy for W_2C layer growth is about 99.5 kcal/mole. Alpha-WC was observed to have an anomalously low layer-growth rate and a very high activation energy (≈300 kcal/mole), while the layer-growth rate of β-WC_{1-x} is comparable to that of the other transition metal monocarbides. The growth of the molybdenum carbides was studied from 1200 to 2100°C. Below ≈1415°C, Mo_2C growth with an activation energy of 114 kcal/mole is observed, while above this temperature the activation energy is only 68 kcal/mole. Author (NSA)

N68-35756# Kernforschungsanlage, Juelich (West Germany)
THE PHOTOLYSIS OF AMMONIA AT 2062 Å IN THE PRESENCE OF PROPANE
W. E. Groth, U. Schurath, and R. N. Schindler Apr. 1968 29 p refs
(JUL-523-PC) CFSTI: HC$3.00/MF$0.65

Ammonia was photolyzed at 2062 Å in the presence of propane as a hydrogen atom scavenger. The only photo process at this wavelength is shown to be: (a) $NH_3 + h\nu$ (2062 Å) → NH_2 ($^2B_1$) + H H_2, N_2, H_2H_4, C_3H_8, C_6H_{14}, $i\text{-}C_3H_7NH_2$ and small amounts of unidentified amines were produced in the photolyses. All products were determined quantitatively as functions of absorbed irradiation dose. A reaction mechanism is developed on the basis of the observed quantum yields. The ratio of disproportionation to addition reactions between amino and propyl radicals is obtained to be 0.21±0.07. Author

N68-35774# Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Chemische Analyse.
2 θ VALUES FOR X-RAY ANALYSIS WITH PENTAERYTHRITE, (332), 2d = 8,74 Å AS THE ANALYZING CRYSTAL [2 θ-WERTE FUER DIE ROENTGENSPEKTRALANALYSE MIT PENTAERYTHRIT, (332) 2d = 8,74 Å ALS ANALYSATORKRISTALL]
C. Freiburg and W. Reichert Jun. 1968 82 p refs In GERMAN
(JUL-532-CA) CFSTI: HC$3.00/MF$0.65

The values, obtained by computer calculation, are arranged in two tables. The first table lists the 2 θ values in order of increasing wavelength and gives the element symbol of the wavelength, order of the crystal reflection, and the wavelength in angstroms. In the second table, the 2 θ values of the first table are rearranged to appear in order of the periodic number of the elements. K.W.

N68-35792# Mound Lab., Miamisburg, Ohio.
CHROMIUM(III) ERIOCHROME BLUE BLACK R: A NEW CHELOMETRIC INDICATOR
G. L. Silver and R. C. Bowman 1 Aug. 1968 8 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1536) CFSTI: HC$3.00/MF$0.65

The preparation and some properties of a new indicator suitable for the determination of metal ions with ethylenediamine-tetraacetic acid (EDTA) is described. Titrations of calcium, cadmium, manganese, and zinc illustrate the applicability of the indicator in chelometry. Author (NSA)

N68-35805# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
RESEARCH ON ANHYDROUS HYDRAZINE SYNTHESIS [RECHERCHES SUR LA SYNTHESE DE L'HYDRAZINE ANHYDRE]
Gilbert Gaussens (Ph.D. Thesis—Paris Univ.) 1967 108 p refs In FRENCH
(CEA-R-3379)

The radiolysis of pure liquid ammonia was investigated and the fundamental importance of the dose rate and of the dose on the yield of radiolytic products was demonstrated. By using a capture solute at concentrations of between 10^{-3} and 1.2 moles/l, it was possible to determine the yields of radicals and of molecules in the irradiated pure ammonia. By systematically varying the physicochemical parameters, the most favorable conditions for carrying out the radiosynthesis were determined. The maximum radiochemical yield of the hydrazine obtained had a value G (N_2H_4) = 2.2/100 eV. An analysis of the molecular yields in the presence of deuterated solutes makes it possible to explain partially the role of the capture species. An installation for the continuous production of hydrazine is described, and an economic study of the process given. Results show that the yields of hydrazine obtained justify an industrial application, especially if strong radiation sources are available, for example nuclear reactors. Author (NSA)

N68-35840# Arizona Univ., Tucson.
LUMINESCENCE OF METAL COMPLEXES Annual Technical Progress Report, 1967–1968
15 Jun. 1968 5 p refs
(Contract AT(11-1)-773)
(COO-773-15) CFSTI: HC$3.00/MF$0.65

Developments are reported for studies on: polarization of electronic transitions in chromium acetylacetonate; relaxation of ^2E states in Cr(III) complexes; low temperature spectra of Cr(III) complexes; and ESR studies on $Cr(C_2O_4)^{3-}{}_3$. NSA

N68-35887# Telefunken G.m.b.H., Ulm (West Germany).
DEPOSITION OF SILICON DIOXIDE FILMS ON GERMANIUM BY HYDROLYSIS AND INVESTIGATION OF PROPERTIES OF SUCH LAYERS [ABSCHEIDUNG VON SILIZIUMDIOXID-SCHICHTEN AUF GERMANIUM DURCH HYDROLYSE UND UNTERSUCHUNG DER EIGENSCHAFTEN DIESER SCHICHTEN]
I. Fraenz, M. Kuisl, and W. Langheinrich 2 Jul. 1968 59 p refs In GERMAN Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-68-51) CFSTI: HC$3.00/MF$0.65

Two papers are combined which report on investigations of diffusion-inhibiting and passivating surface layers on semiconductors by means of radiochemical as well as other chemical and physical methods and which describe a new method of producing such layers. All these investigations which are being continued serve to further develop technological processes under the objective of increasing the reliability of system components. The first paper "Deposition of Silicon Dioxide on Germanium by Hydrolysis of Silicon Tetrachloride" outlines fundamental studies made to produce thin silicon dioxide layers on various substrata, in particular on germanium. The second paper, entitled "Properties of Silicon Dioxide Layers Deposited by Hydrolysis", reports on exhaustive technological investigations of these layers as to their use as diffusion-inhibiting layers. Author

N68-35909# Los Alamos Scientific Lab., N. Mex.
MASS SPECTROMETRIC STUDIES OF PLUTONIUM COMPOUNDS AT HIGH TEMPERATURES. 1. THE HEATS OF VAPORIZATION OF GOLD AND PLUTONIUM AND THE HEAT OF DECOMPOSITION OF PLUTONIUM MONONITRIDE
R. A. Kent and J. A. Leary 17 Jul. 1968 20 p refs
(Contract W-7405-ENG-36)
(LA-3902) CFSTI: HC$3.00/MF$0.65

The mass spectrometer–Knudsen cell apparatus, constructed and employed to measure the enthalpy of vaporization of gold, the vapor pressure and enthalpy of vaporization of plutonium, and the partial pressures and enthalpies of formation of Pu(g) and N_2(g) above solid PuN, is described. In the temperature range from 1426 to 1658°K, liquid plutonium vaporizes predominately to the monomer with the vapor pressure given by the least-squares equation: $\log_{10} P(atm) = (4.924 \pm 0.120) - 17420 \pm 184/T°K$. The standard enthalpy of vaporization is $\Delta H°_{298} = 83.0 \pm 0.5$ kcal. mole^{-1}. In the temperature range from 1658 to 1976°K, PuN(s) decomposes invariantly according to the reaction PuN(s) = Pu(g) + 1/2 N_2(g), with an enthalpy of reaction $\Delta H°_{298} = 156.1 \pm 2.5$ kcal. mole^{-1}. The partial pressure of Pu(g) above solid PuN is given by: $\log_{10} P_{Pu}(atm) = (6.436 \pm 0.055) - 21958 \pm 98/T°K$. The standard enthalpy of formation of solid PuN is calculated to be $\Delta H°_{f298} = -73.1 \pm 2.7$ kcal. mole^{-1} Author (NSA)

N68-35921# California Univ., Berkeley. Lawrence Radiation Lab.
A COMPILATION OF SELECTED THERMODYNAMIC AND TRANSPORT PROPERTIES OF BINARY ELECTROLYTES IN AQUEOUS SOLUTION
Thomas W. Chapman and John Newman May 1968 297 p refs
(Contract W-7405-ENG-48)
(UCRL-17767) CFSTI: HC $3.00/MF $0.65

Data from the literature on properties of binary electrolytes in aqueous solutions are tabulated. The properties include the density, the viscosity, the conductivity, the transference number, the diffusion coefficient, and the activity coefficient. Author (NSA)

N68-35960# Sandia Corp., Albuquerque, N. Mex.
A STUDY OF THE PARAMETERS USED IN THE DETERMINATION OF BERYLLIUM IN AIR SAMPLES USING THE EMISSION SPECTROGRAPH
Ednarae Gross May 1968 13 p refs
(Contract AT(29-1)-789)
(SC-TM-68-234) CFSTI: HC $3.00/MF $0.65

Some changes in the parameters used in determination of beryllium in air samples using the emission spectrograph improved reproducibility and reduced error. The parameters studied were slit width, electrode waterproofing, burning rate of Be, and the slit height. Author (NSA)

N68-35967# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente.
PHYSICOCHEMICAL REPORT ON METALLURGICAL ANALYSIS [PHYSIKOCHEMISCHE BEITRAEGE ZUR METALLKUNDLICHEN ANALYSE]
H. Sundermann Apr. 1968 78 p refs In GERMAN
(KFK-692)

The fundamentals of methods of operation and technical developments in phase exposure and phase separation from metallic materials for analytical metallurgical studies of reactions in alloys are reported. A review is given of the potentiostatic electrolysis for phase isolation from steels. The effects of electrolytes, the alloying elements, and heat treatment on the current density potential curve or on the decomposition potential of the metallic matrix and its structural constituents are shown. An electronic potentiostat was developed for carrying out the electrolysis. The potential distribution for special electrode systems was calculated for estimation of the geometric effects on the electrolytic attack. The separation of phases was then considered. The theory of repulsive effect between dipoles and a periodic magnetic field under the effect of dipole hysteresis was developed. The development of a magnetic separation method is described. Separations carried out show the separation sharpness attainable. Author (NSA)

N68-35990# Atomic Power Development Associates, Inc., Detroit, Mich.
FEASIBILITY STUDY OF IN-LINE DETECTOR FOR HYDROGEN IN SODIUM
J. H. Coleman and E. F. Hill Mar. 1968 45 p refs
(Contract AT(11-1)-865)
(APDA-222) CFSTI: HC $3.00/MF $0.65

The principle of the detector involves using a catalytic surface to oxide hydrogen to water as it emerges from a diffusion membrane which is in contact with liquid sodium containing hydrogen. Surface oxidation creates a hydrogen pumping action; the amount of water formed is proportional to the amount of hydrogen contained in the sodium, thus providing a measure of hydrogen concentration. The results of the laboratory program showed that the principle is applicable to the detection and removal of hydrogen in sodium and that a quantitative relationship exists between the hydrogen contained in sodium and the amount of water formed in the oxidizing gas. A relationship was shown to exist when hydrogen was added as a gas, as sodium hydroxide, as water, and as sodium hydride. NSA

N68-36009# Argonne National Lab., Ill.
SEMIANNUAL REPORT OF THE CHEMISTRY DEPARTMENT, CENTER FOR NUCLEAR STUDIES AT FONTENAY-AUX-ROSES, DIRECTION OF NUCLEAR MATERIALS AND FUELS, DECEMBER 1966–MAY 1967, SECTIONS 1 AND 4
May 1967 63 p refs Transl. into ENGLISH from French Report no. CEA-N-856, May 1967 p 5–56, 79–86
(ANL-Trans-810) CFSTI: HC $3.00/MF $0.65

Reported are studies focusing on: (1) the development of chemical analyses for determinations in plutonium; (2) the preparation of solutions of irradiated or re-constituted fuels (uranium and plutonium); (3) developments in gas analyses of uranium, zirconium and their alloys, vanadium, and ferrous metals; (4) the development of chemical analyses of beryllium; and (5) methods for analysis of enriched uranium. S.C.W.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-34820 Johns Hopkins Univ., Baltimore, Md.
STATISTICAL ESTIMATION OF INTRINSIC DIMENSIONALITY AND PARAMETER IDENTIFICATION
Gerard Vernon Trunk (Ph.D. Thesis) 1967 119 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-13835

A test statistic is derived through the principle of invariance. The asymptotic distribution of this static is found for the case of the infinite signal collection. This distribution is assumed for a finite collection, and the theory of multiple hypothesis testing is used to estimate the intrinsic dimensionality. The probability of a correct decision is calculated. Since many assumptions were made, these calculations are verified by a Monte Carlo study. The method is shown to be consistent, and the singular case in non-metric data is discussed. By using an appropriate group of transformations a specific set of parameters can be identified in the following manner: The intrinsic dimensionality is found before and after the appropriate transformation. A change in dimensionality indicates the absence of the parameter of interest. Finally, the case of signal plus additive noise is considered. First, a signal-to-noise ratio is proposed for a collection of signals. Next, a filtering process, subgrouping (division of the signal collection into several mutually exclusive subgroups), is based on an estimate of the signal-to-noise ratio. Dissert. Abstr.

N68-34848 Polytechnic Inst. of Brooklyn, N. Y.
A CLASS OF DIMENSION CHANGING MAPPINGS AND ITS APPLICATION TO BANDWIDTH COMPRESSION
Theodore Bially (Ph.D. Thesis) 1967 137 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 67-13379

The dissertation is divided into two parts. The first is concerned with the characterization and formation of a large class of mappings of the desired type, referred to as self-similar space filling curves. Several functional relationships between the coordinates of the points of an N-dimensional cube and the points of the line onto which it is mapped are derived, and numerical techniques for the

generation of space filling curves are presented. The mappings are ultimately characterized by digital state diagrams of finite size. This format is particularly well suited to synthesis by electronic means. A bound on the number of states required in the diagrams of the mappings is derived in terms of several initial parameters, and a procedure by which this bound will not be exceeded is offered. The second part is concerned with the application of space filling curves to bandwidth compression and includes system block diagrams, a specific design example, and several examples of the types of noise probability distributions which occur at the receiving end of a system which is operating in the presence of additive Gaussian noise. Dissert. Abstr.

N68-34906*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A TDM SYNCHRONIZATION SYSTEM FOR MULTIPLE ACCESS SATELLITE COMMUNICATION

Walter K. Allen, ed. and James L. Singleton, ed. Sep. 1968 212 p refs

(NASA-TM-X-63338; X-733-68-354) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Experiments in measuring time error, acquisition time, and range prediction accuracy indicated the feasibility of a Time Division Multiple Access (TDMA) system in which several ground stations simultaneously share a satellite repeater. The station designated as master transmits a repetitive sync burst to the other stations via satellite, and this provides the time reference for a time division multiplex format with a number of time intervals. Each station can transmit during an assigned interval without causing interference to the other stations. In order to adequately simulate an actual communications system, each terminal was provided with the capability of inserting unmodulated carrier bursts at any point of the format; and this, in turn, provided the means for simulating any desired amount of system loading. Typical timing error was 25 nanosec, timing error was always less than 75 nanosec, and acquisition time for a terminal averaged 25 sec and was always less than one min. M.W.R.

N68-34948*# Communications and Systems, Inc., Falls Church, Va.

THE STUDY OF SEQUENTIAL DECODING TECHNIQUES FOR SPACECRAFT TELEMETRY SYSTEMS Final Report, 12 Jan.–12 Jun. 1968

12 Jun. 1968 183 p refs

(Contract NAS5-11503)

(NASA-CR-98877) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The object of this report is to summarize the results of a study performed on the application of convolutional encoding-sequential decoding to spacecraft telemetry systems. This report deals with the application of this coding technique to both near earth and deep space telemetry missions. The primary area of investigation for near earth missions involved a consideration of the IMP PCM telemetry system. This investigation resulted in the conclusion that there are no apparent problem areas in the design of this system. In investigating the channel characterizing the IMP telemetry system it was noted that the tape recorder equipment may give rise to burst type errors. However, the IMP sequential decoder can correct these errors at the expense of computer time. In order to provide insight into the treatment of burst errors simulation results are presented which demonstrate the effect of burst errors, of length 2–6, on a sequential decoder. In considering the design of a coherent deep space telemetry link, using convolutional encoding-sequential decoding, an important limitation is the ability to provide a suitable phase reference. In the area of code rate selection it was found that a basic limitation exists due to the spacecraft oscillator stability. The results of this work imply that an optimum code rate exists for a specified oscillator stability, data rate and carrier frequency. Sequential decoding using quantized channel outputs is analyzed; theoretically optimum threshold settings are derived and practical implementation is discussed. Author

N68-34970 Michigan Univ., Ann Arbor.

HELICAL AND LOG CONICAL HELICAL ANTENNAS LOADED WITH AN ISOTROPIC MATERIAL

George Gerald Rassweiler (Ph.D. Thesis) 1967 144 p

Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-15678

The determinental equation for a bifilar tape helix loaded inside with a full core of isotropic material is numerically solved for the complex propagation parameter of the primary current wave as a function of frequency. The complex propagation parameter of the source-free problem is shown to be related to the dominant leaky wave pole of the corresponding gap-source helix problem. The results of the tape helix calculation are compared to a simplified slow-wave, inside-loaded sheath helix solution. Both methods show that such an antenna with a small pitch angle ψ has a diameter reduction factor for backward fire radiation of approximately $\sqrt{(1/\mu + 1)/\epsilon + 1)}$ where μ and ϵ are the relative permeability and permittivity constants, respectively. Thus, the loading does achieve diameter reduction by slowing the phase velocity of the primary current wave. Dissert. Abstr.

N68-35009 Polytechnic Inst. of Brooklyn, N. Y.

THE PERFORMANCE OF M-ARY FEEDBACK COMMUNICATION SYSTEMS

Frederick Frank Kreussling (Ph.D. Thesis) 1967 171 p

Available from Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 67-13400

The effects of adding a feedback capacity to existent M-ary communication systems perturbed by white Gaussian noise are considered. This subject is of interest because it is possible to reduce the power requirements of the primary transmitter by the addition of a feedback link operated at a substantially higher power level. Previous investigators in this area have dealt primarily with binary systems; in this dissertation, more general treatments of M-ary orthogonal and M-ary PAM systems are presented. Both systems are analyzed when performing with decision feedback and information feedback; in all cases it is found that the use of information feedback prpvides superior performance in that less power is required for a given increase in average process time. A very significant result for the orthogonal information feedback case is that the use of two signal feedback is superior to and simpler than the three signal feedback system. It is also shown that if bandwidth is not a serious restriction, the orthogonal information feedback communication system provides a significantly greater power savings than an error coded system using fairly long codes. Dissert. Abstr.

N68-35016 Johns Hopkins Univ., Baltimore, Md.

DETECTION OF RANDOMLY PERTURBED SIGNALS OF UNKNOWN A PRIORI PROBABILITIES

Benjamin Joseph Roscoe (Ph.D. Thesis) 1967 124 p

Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-13825

The problem of finding a sequence of decision rules that converges to the Bayes decision rule is investigated for the case where the a priori probability of the signals are initially unknown and cannot be determined by any means other than from the received data. It is assumed that the received data includes the effects of signal perturbations due to the communication channel and additive white normal noise. The approach to the problem and the criterion of optimality are based upon the general Bayes detection system. A solution to the problem is found for the more general case of multiple-alternative detection however, most of the subsequent results are for binary detection. It is shown that the desired sequence can be found provided that a set of consistent estimators of the a priori probabilities can be constructed. Dissert. Abstr.

N68-35106# Queens Univ., Kingston (Ontario). Electrical Engineering Dept.
A SIMULATION AND STUDY OF FREQUENCY SHIFT KEYING SIGNALS
David H. S. Ko [1968] 147 p refs
(Contract DRB-513003)
(RR-68-2) CFSTI: HC $3.00/MF $0.65

A low frequency simulation of a transmitter for frequency-shift-keying (F.S.K.) waves has been constructed. The F.M. modulator-oscillator is described together with three binary signal sources, the so-called "random telegraph", the "penny-toss" and the ASCII-coded teletype signals, which have been used as models of pulse width modulation (PWM), Pulse Code Modulation (PCM), and teletype signals respectively. The transmitter serves as the first part of a transmitting and receiving system for F.M. signals. A comparison is made of the spectrum of the simulator output with theoretical calculations derived by Bennett and Rice, and Wittke. This serves to evaluate the performance of the transmitter. Then, the validity of the "penny-toss" wave as a model for the ASCII teletype code signals is examined by comparing the F.M. spectra of the two signals. Author

N68-35132# California Univ., Livermore. Lawrence Radiation Lab.
SIGNAL TO NOISE ENHANCEMENT
V. R. La Torre *In its* Noise Reduction Conf. [1968] p 160–168 refs (See N68-35118 22-23)

A very broad treatment of the problem of signal-to-noise enhancement is presented, the majority of the discussion centering on the use of correlation detection using matched filters. Some of the problems encountered in practice are described, and an optical delay line matched filter is analyzed to illustrate one type of system for obtaining protection from interference that was assumed to be uncorrelated. Author

N68-35140*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE DECREASE OF THE RADAR CROSS SECTION OF THE APOLLO COMMAND MODULE DUE TO REENTRY PLASMA EFFECTS
John W. Marini Washington Sep. 1968 22 p refs
(NASA-TN-D-4784) CFSTI: HC $3.00/MF $0.65 CSCL 17I

A number of mechanisms have been proposed to explain the observed decreases. One of these is the plasma sheath which, at certain combinations of altitude and speed, may act as an absorbant coating. In another, the inhomogeneous plasma sheath may present to the incident radar wave a reflecting surface having, because of its shape, a lower cross section than the original body surface. With the reentry object, radar frequency, and radar look-angle fixed, the regions where these mechanisms are likely to have effect depends primarily on the altitude and speed of the object. The regions of decrease caused by the two mechanisms listed are determined. The case considered is that of a C-band radar observing a large directly approaching object. Neither the possibility of a decrease caused by photoionization nor the effect of the sheath on a radar observing the object at other than a head-on view has yet been treated. Because of the incomplete and tentative nature of the analyses and because of a lack of field data on reentries of the Apollo type, it is premature to say whether the effects constitute a practical tracking problem. Author

N68-35147*# Radiation, Inc., Melbourne, Fla.
NIMBUS B PCM TELEMETRY SUBSYSTEM, VOLUME 1, SECTIONS 1 THROUGH 8 Final Report
15 Aug. 1968 315 p refs
(Contract NAS5-10139)
(NASA-CR-96892) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Design, manufacture, and testing of the spaceborne PCM telemetry subsystem, bench test equipment, and ground stations are described. The work on the PCM telemetry subsystem, which is composed of a telemetry electronics unit and a PCM telemetry unit, consisted of minor design modifications, fabrication, assembly, and improvements in the ability to withstand environmental stresses. Development and fabrication as well as functional, physical, and operational characteristics of the bench test equipment are described. Four ground stations were modified extensively to include equipment to handle the substantially increased capability of the PCM telemetry subsystem. The modifications included addition of 5220 bit synchronizers, digital decommutation capability, time code display, expanded simulator capability, added event recorders, and changes in the cables and cabinet. Reliability, qualification, and acceptance tests are described in detail. K.W.

N68-35160 Rutgers Univ., New Brunswick, N. J.
IMPULSIVE NOISE IN DIFFERENTIAL FOUR-PHASE MODULATION SYSTEMS
Marvin Kurland (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-14727

Consideration is given to a method of predicting errors and to other problems concerning digital data transmission in system employing differential four-phase modulation and transmitting data at the rate of 2400 bits/sec. This data set was selected for these investigations because of its availability and its extensive use. It is also shown that the method presented in this thesis for the prediction of error rates is also applicable to other types of modulation systems employing product demodulation. A noise model consistent with current knowledge is presented and this model is used to predict a threshold which exists in the four-phase data set. This threshold is a signal-to-noise ratio such that if the noise is below this level, no errors can occur. This ratio was derived for two cases: (1) a long noise burst, such as a multifrequency pulsing tone, and (2) a short noise burst, such as a switching transient. These ratios were found to be +7.28 db for the long pulse and 0 db for the short burst. These results were corroborated by experimental findings. This model was also used to derive an expression for the probability of making an error. Dissert. Abstr.

N68-35172*# Ohio State Univ., Columbus.
THE REFLECTION COEFFICIENT OF A TEM MODE PARALLEL-PLATE WAVEGUIDE ILLUMINATING A CONDUCTING SHEET: THE LARGE WEDGE ANGLE CASE
W. D. Burnside, L. L. Tsai, and R. C. Rudduck Washington NASA Sep. 1968 46 p refs
(Grant NGR-36-008-048)
(NASA-CR-1174) CFSTI: HC $3.00/MF $0.65 CSCL 20N

The reflection coefficient of a large wedge angle parallel plate waveguide operating in the TEM mode and illuminating a perfectly conducting sheet is analyzed by wedge diffraction techniques. The interactions between the waveguide aperture and the reflector are represented by bouncing cylindrical waves. The scattering of these cylindrical waves by the guide aperture produces four subsequent component cylindrical waves, which in turn reflect back onto the guide. These component cylindrical waves are determined through analysis and are represented by equivalent line sources which then couple power into the guide. The continuation of this reiteration process then includes the contribution of the higher order interactions (or bounces). Good agreement is obtained between the calculated results and measurements. The calculated results also agree with those obtained by the plane wave approach in the region of mutual validity for both analyses. Author

N68-35174*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
THE DESIGN OF A PULSE POSITION MODULATED (PPM) OPTICAL COMMUNICATION SYSTEM
Sherman Karp and Robert M. Gagliardi (Univ. of Southern Calif., Los Angeles) Washington Oct. 1968 25 p refs
(NASA-TN-D-4814) CFSTI: HC $3.00/MF $0.65 CSCL 17B

In recent literature the advantages of an idealized narrow width pulse position modulated (PPM) optical communication system, using coherent sources and direct photo-detection, have been shown. In this report, the practical design of such an operating PPM link is considered. System performance, in terms of error probabilities and information rates, are derived in terms of key parameters, such as power levels, number of PPM signals, pulse width, and bandwidths. Both background radiation and receiver thermal noise are included. Design procedures utilizing these data are outlined. Whenever possible, optimal design values and parameter trade-offs, in terms of maximizing information rate or minimizing transmitter power, are shown. The effect on performance of photomultipliers and their inherent statistics is also presented. Although the basic analysis is derived in terms of photon counts, the necessary system optics equations are introduced to allow for overall optical hardware design. The primary underlying assumption is that synchronization is maintained at all times between transmitter and receiver. Author

N68-35197 Texas A&M Univ., College Station.
SYNTHESIS OF WIDEBAND LINEAR ARRAY ANTENNAS WITH TAYLOR DISTRIBUTED ELEMENT POSITIONS
Robert Dosher Meeks (Ph.D. Thesis) 1967 182 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-16467

A technique for synthesizing wideband linear array antennas with equally excited elements positioned according to a Taylor distribution function g(p) is developed. The discrete element array is considered to be a radiating aperture; hence, an equivalence for the far field pattern |S(V)| of an array and that of a radiating aperture is derived with the use of Fourier transform theory. In order to investigate the limitations on the sidelobe levels and the directivity of the array, two regions of the average field pattern are considered. Region 1 has equal sidelobe levels in the average field pattern, and Region 2 has decaying sidelobe levels in the average field pattern. The method of spacing the elements in the array is based on an approximation of the area under the g(p) selected. Equal area increments are computed and one element per area increment is used in order to establish an aperture distribution of electric field. Numerical values of the probability distribution functions, the bounding values of directivity, the directivity, and the peak sidelobe levels are computed for design sidelobe levels of 15 and 25 decibels. Dissert. Abstr.

N68-35238 National Lending Library for Science and Technology, Boston Spa (England).
STUDY OF VOICE-FREQUENCY RADIO TELEGRAPHY SYSTEMS
H. Retting 5 Sep. 1968 29 p refs Transl. into ENGLISH from NTZ-Nachrtech. Z. (Brunswick), v. 19, no. 9, Sep. 1966 p 513-526 (TRANS-2383) Available from Natl. Lending Library, Boston Spa, Engl.

Experiments are described which concern the channel spacing requirements in relation to the transmission speed of telegraph signals over voice-frequency radio telegraphy systems using time division multiplexing. The study differentiates between unprotected 50-baud start-stop systems and error protected synchronous systems with modulation rates up to 200 bauds and automatic repetition request equipment. Two voice-frequency telegraphy systems were used in the experiments, one of which permits the use of channel spacings of 680, 340, and 170 Hz, the other working with channel spacings of 680 Hz only. Both systems can be used for single or double sideband and permit the use of space or frequency diversity separately or concurrently. It was found that with a modulation rate of 200 bauds, channel spacings of 340 Hz with a deviation of ± 85 Hz are satisfactory even for transmission over long distances. Difficulties were encountered only in north-south transmissions across the equator when using 5 m/sec elements. When using unprotected 50-baud signals with 170 Hz spacings, allowance must be made for a high number of errors even over short distances. K.W.

N68-35242# Polytechnic Inst. of Brooklyn, N. Y.
AN ANALYSIS OF DOMESTIC SATELLITE COMMUNICATIONS IN THE UNITED STATES
Stuart N. Goodman (M.S. Thesis) Jun. 1968 239 p refs
(AD-673031)

The possible application of communications satellites for domestic application in the United States has been proposed. This represents an unprecedented application for communications satellites; that is, for distances previously thought to be too small for communications satellites to be economically feasible, and in an area where terrestrial communications facilities are already well advanced. This essay is an attempt to study and analyze the financial, economical, and legal factors and concepts that are relevant to this method of communications. Author (TAB)

N68-35274 National Lending Library for Science and Technology, Boston Spa (England).
A TEST SET FOR THE DETERMINATION OF GROUP DELAY IN THE MILLIMETRE WAVELENGTH RANGE
H. Ruckdeschel 10 Sep. 1968 15 p refs Transl. into ENGLISH from NTZ-Nachrtech. Z. (Brunswick), v. 20, no. 6, Jun. 1967 p 325-328
(TRANS-2492) Available from Nat. Lending Library, Boston Spa, Engl.

A test set is described for determining the law of variation of group delay of microwave four-poles with an accuracy of ± 0.15 ns. The group delay of the item under test is measured automatically in the frequency range from 30 to 42 GHz. The test set supplies a plotted curve that gives the measured change in group delay as a function of frequency. Time-delay and frequency scales can be adjusted within wide limits. The waveguides of the test set have rectangular cross section with dimensions a × b = 71 mm × 3.55 mm. The measuring device operates on the basis of the Nyquist method. The value of the slot frequency is 2 MHz. By replacing the microwave components of the test set with similar ones having different waveguide cross section, the measuring device can be used in all frequency ranges of the millimetre wave region. Only changes in time delay as a function of frequency can be measured. In each measurement, a frequency-dependent basic time delay remains unknown. The measuring device is a laboratory prototype version. Author

N68-35314# Mitre Corp., Bedford, Mass.
DIFFERENT AND MORE DIRECT APPROACH TO THE INVERSE EDGE BACKSCATTERING PROBLEM
Nicholas M. Tomljanovich Apr. 1968 29 p refs
(Contract AF 19(628)-5165; ARPA Order 596)
(MTR-482; ESD-TR-68-112; AD-672764)

In a report R. M. Lewis has shown how the body motion and geometric parameters of an edge located on a torque-free axi-symmetric conducting body could be determined by knowing the short pulse backscattered cross sections of the isolated edge at two different polarizations as functions of time. The purpose of this report is to indicate another more direct and more practical approach to the inverse edge backscattering problem still utilizing the same measured data as Lewis's. The convenience of one approach over the other will become apparent in this paper. Author (TAB)

N68-35333# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LESTR-2 TELEMETRY GROUND SYSTEM
John H. Helfrich Jun. 1968 21 p
(Contract A.- 19(628)-5167)
(TN-1968-19; ESD-TR-68-188; AD-672959)

A new telemetry ground station identified as LESTR-2 and intended for use with LES-5 and LES-6 satellites is described for the purpose of defining interface requirements and available outputs. Like the previous ground station, LESTR-2 provides a printed paper-tape output as well as a magnetic-tape output. In addition, however, it includes a number of new features and outputs such as selectable-word printout from a second printer, telephone data-set output for remote real-time data processing, and automatic frame-format identification. Author (TAB)

N68-35379# Michigan Univ., Ann Arbor. Cooley Electronics Lab.
THE THEORY OF SIGNAL DETECTABILITY: EXTENSION TO THE DOUBLE COMPOSITE HYPOTHESIS SITUATION
Ronald L. Spooner Apr. 1968 241 p refs
(Contract Nonr-1224(36))
(TR-192; Rept.-3674-16-T; AD-672920)

The theory of signal detectability is extended to situations in which each of the two possible hypotheses are composite. The specific problem considered is that of detecting signals mixed with noise for examples in which uncertainties exist in both the signal and noise processes. The uncertain process parameters are considered to be both time invariant and time varying during the detection interval. A general optimum processor for the doubly composite detection situation is developed. The sequential processing technique results in a receiver design which provides practical memory requirements for arbitrary observation interval lengths and also exhibits adaptive or learning characteristics. Applications of the general theory to both the time invariant and time varying cases are considered. In addition, the adaptive nature of the sequential receiver is demonstrated both analytically and by digital computer simulation. For the time varying situation, the general theory is applied to develop a sequential optimum receiver for the detection of a certain signal in noise with uncertain and time varying parameters. The sequential realization results in a receiver which utilizes a practical memory size and attempts to track the varying parameters of the noise. These general results are then applied to the problem of detecting a signal in noise of varying level. The performance for this latter case is evaluated in terms of ROC curves. Author (TAB)

N68-35419# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A SHALLOW-CAVITY UHF CROSSED-SLOT ANTENNA
Charles A. Lindberg Mar. 1968 24 p refs
(Contract AF 19(628)-5167)
(TR-446; ESD TR-68-22; AD-672763)

The shallow-cavity crossed-slot antenna is a UHF radiator designed primarily for use on a high-speed aircraft operating as the airborne terminal in a satellite-to-air communications link. The requirements, design analysis and performance characteristics are described. The antennas shallow profile makes it attractive either as a paste-on or flush-mounted type radiator. Near-hemispherical radiation coverage is provided. Author (TAB)

N68-35425# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
ELECTROMAGNETIC INTERFERENCE MEASUREMENT METHODOLOGY, COMMUNICATION EQUIPMENT Quarterly Report, 1 Feb.–30 Apr. 1968
William R. Free Aug. 1968 36 p refs
(Contract DAAB07-68-C-0189)
(A-1075-1; ECOM-0189-1; QR-1; AD-673275)

During this reporting period, primary emphasis has been directed toward the development of techniques for measuring radiated interference and susceptibility in shielded enclosures over the frequency range from 20 MHz to 200 MHz. A theory has been developed to explain the presence of coupling nulls in the near-field of radiating sources in shielded enclosures at low frequencies (below 100 MHz). If this theory can be validated, additional approaches to the solution of the measurement problems in the 20 to 200 MHz frequency range will be available. An experimental study program to determine the optimum length for the hood of a hooded antenna was initiated during this period. Preliminary results from this study indicate that it may be possible to obtain an essentially constant beamwidth over a frequency bandwidth of greater than 3:1. Author (TAB)

N68-35439# Naval Weather Service, Washington, D. C.
THE ANALYSIS AND FORECASTING OF ATMOSPHERIC RADAR REFRACTIVITY
Jul. 1967 29 p refs
(NAVAIR-50-1P-1; AD-672840)

This publication details procedures whereby atmospheric refractivity is determined by using the AROWAGRAM (OPNAV FORM 3140-3) with a plastic overlay (NAVAIR 50-1P-1A). The overlay is distributed separately through normal supply channels for convenience. Since use of the AROWGRAM is peculiar to Navy activities, no distribution of the plastic overlay beyond the Department of the Navy is contemplated. This publication is issued as an aid to Naval Weather Service Units in satisfying an increasing requirement of the operating forces for radar refraction data. An attempt has been made to consolidate, simplify, and up-date available sources of information. Brevity and simplicity have been stressed to encourage wide usage, and no prior knowledge of the subject is assumed. The use of mathematical equations and formulas has been completely eliminated. Author (TAB)

N68-35454# Atlantic Research Corp., Alexandria, Va. Jansky and Bailey Engineering Dept.
TROPICAL PROPAGATION RESEARCH Semiannual Report, 1 Jan.–30 Jun. 1967
L. G. Sturgill Jul. 1967 162 p refs
(Contract DA-36-039-SC-90889; ARPA Order 371)
(SAR-9; AD-673142)

This is the ninth semiannual report of a research project to study radio propagation in tropical areas with heavy vegetation. The experimental results reported here are from the first series of Thailand (Area 2). The test area, which receives about 90 inches of rainfall annually, is covered with extremely thick jungle. Graphs are presented of basic transmission loss as a function of distance out to 1.4 miles for frequencies of 25, 50, 100 and 250 Mc/s using different transmitting antenna heights, polarizations and transmission paths. The receiving antenna height is fixed at 6 feet. Certain of these tests are compared with identical ones made previously in the jungles near Pak Chong, Thailand, (Area 1), where the vegetation is significantly lower and less dense. The climate in the test area is also described and compared with the climate at Area 1. Author (TAB)

N68-35486# Mitre Corp., Bedford, Mass.
NUMERICAL EVALUATION OF GEOMETRICAL OPTICS RADAR CROSS SECTION
M. R. Weiss May 1968 24 p refs
(Contract AF 19(628)-5165; ARPA Order 596)
(MRT-431; ESD-TR-68-111; AD-672965)

A numerical technique for evaluation of the geometrical optics radar cross section of a general doubly curved convex conducting body is described. Numerical results are given with comparisons to exact techniques. Author (TAB)

N68-35487# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THEORETICAL FUNDAMENTALS OF RADAR

V. E. Dulevich, A. A. Korostelev, Yu. A. Melnik, N. I. Burenin, and A. V. Petrov 22 Nov. 1967 979 p refs Transl. into ENGLISH of "Teoreticheskie Osnovy Radiolokatsii" Izd. Radiosov., 1964 732 p

(FTD-HT-67-192; AD-673149)

The book examines the principles of radar, methods of coordinate measurement and scanning and circuits for radar stations of three types: with an operator, a continuous computer installation and a digital computer. It presents the characteristics of radar signals with a consideration of the statistical regularities that occur in the reflection of radio waves their propagation, and the presence of noise on the signal. The book describes methods of building optimal and near optimal receivers considering statistical, spatial and frequency time characteristics of the signal and interference. The book estimates the maximum capacities of radar in detecting and measuring target coordinates. It gives a statistical evaluation of target position or trajectory on the basis of radar measurement data. In conclusion, the book describes methods of combating various types of interference and the operating principles of passive radar systems. Author (TAB)

N68-35522*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

PROBLEMS AND PROGRAMS ON THE USE OF SUBMILLIMETER WAVES IN SPACE

Max R. Nagel Washington 1968 49 p refs

(NASA-SP-182) CFSTI: HC$3.00/MF$0.65 CSCL 09F

The development and the present status of the technology associated with the use of submillimeter waves in field and space applications are described. A compilation of tables, graphs, and other data on the performance of modern submillimeter components is given, along with a list of the most recent literature on the subject. Some of the more significant achievements and the potential of submillimeter waves in the atmospheric and astronomical disciplines and in spaceflight-related operations, are discussed. A review of related programs currently sponsored by the National Aeronautics and Space Administration is given and high priority research needs that may lead to a more effective utilization of submillimeter radiation in space are pointed out. Author

N68-35524*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

HIGHER-ORDER-MODE EFFECTS ON THE APERTURE ADMITTANCE OF A RECTANGULAR WAVEGUIDE COVERED WITH DIELECTRIC AND PLASMA SLABS

C. R. Cockrell Washington Oct. 1968 44 p refs

(NASA-TN-D-4774) CFSTI: HC$3.00/MF$0.65 CSCL 09F

Variational expressions of the admittance of a rectangular aperture covered with homogeneous material are derived. The electric field inside the waveguide is assumed to be a dominant mode plus the first higher order symmetrical mode. Admittance expressions are also given for semi-infinite media. Admittance calculations for polystyrene slabs are given. These calculations are shown to agree closely with results in the literature. Also given are calculations for lossy plasma slabs with electron densities both above and below the critical density. For plasma slabs approximately equal to or greater than $1/3\ \lambda_0$, the medium can be considered semi-infinite, particularly for overdense plasmas. For changing slab thickness, the field of the higher order mode has a greater effect on the admittance in the dielectric slab than in the plasma slab. However, this effect is small; hence, only the dominant mode field is needed for computing aperture admittance. Author

N68-35537*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ELECTROMAGNETIC PROPERTIES OF A CIRCULAR APERTURE IN A DIELECTRIC-COVERED OR UNCOVERED GROUND PLANE

M. C. Bailey, S. N. Samaddar (Raytheon Co., Alexandria, Va.), and Calvin T. Swift Washington Oct. 1968 30 p refs

(NASA-TN-D-4752) CFSTI: HC$3.00/MF$0.65 CSCL 09F

The problem of an aperture fed by a circular waveguide excited in the dominant transverse electric mode (TE_{11}) is considered. The input admittance in the aperture reference plane for the case of a homogeneous lossy dielectric cover of finite thickness and the radiation patterns for the case of no cover are computed from integral transforms, for which a TE_{11} mode variation of the electric field is assumed at the aperture. Computations for the uncoated antenna show that the patterns and aperture admittance are similar to those of a square aperture with a field distribution given by the TE_{01} rectangular mode. It is noted that the uncoated aperture is well matched above midband of the circular waveguide in contrast to the open-end rectangular waveguide. This inherent property would be advantageous for possible use of the open-end circular waveguide as an antenna. Author

N68-35545# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugfuehrung.

THE PREDETECTION MAGNETIC TAPE RECORDING OF AM/FM AND FM/FM TELEMETRY SIGNALS [DIE MAGNETBANDREGISTRIERUNG VON AM/FM-UND FM/FM-SIGNALEN DURCH AUFZEICHNUNG DER EMPFAENGER-ZF]

Helmut Bothe Mar. 1968 40 p refs In GERMAN; ENGLISH summary

(DLR-FB-68-34) CFSTI: HC$3.00/MF$0.65

The predetection magnetic tape recording of AM/FM and FM/FM telemetry signals is investigated. Theoretical evaluations of noise voltages and test measurements on six magnetic tape recorders of different manufacturing companies are described. The estimations and test results are used to determine the suitability of the equipment for storing telemetry signals on magnetic tape. Simple test procedures are indicated. Author

N68-35556# Kiruna Geophysical Observatory (Sweden).

ON THE AMPLITUDE DISTRIBUTION OF SCINTILLATING RADIO SIGNALS FROM ARTIFICAL SATELLITES

A. W. Wernik (Polish Acad. of Sci., Warsaw) and L. Liszka Jan. 1968 26 p refs

(KGO-682)

Twenty-two amplitude distributions of scintillating satellite signals are analyzed. Differences between observed and theoretical Rice distributions are explained by the existence of correlation between orthogonal components of the electromagnetic field vector of the scattered wave. Polarization effects resulting from nonuniform phase distribution are considered. Author

N68-35563# Naval Research Lab., Washington, D. C. Tracking Branch.

THE AIRBORNE SEA STATE RADAR PRINCIPLE AND PRELIMINARY ANALYSIS OF AN EXPERIMENTAL EVALUATION

Arno M. King, Christopher M. Morrow, Chauncey G. Myers, and Calvin L. Moody Jun. 1968 86 p refs

(NRL-MR-1884; AD-672888)

A method of sensing the average angular re-distribution of a radar return from the sea surface is described, and the application of this principle to the measurement of sea state from high altitude aircraft or satellites is discussed. The collection of field data with an airborne 52.5 Mc/sec pulsed radar system is

outlined, and a preliminary analysis of this data is presented. On the basis of this analysis it is tentatively concluded that the angular re-distribution of the radar return at the chosen frequency does not in itself offer a means of unambiguously determining ocean wave heights. By considering other characteristics of the radar return together with angular scattering a useful description of the sea surface may be possible, and such techniques will be considered during a further more detailed analysis of the field data. This work will be described in a subsequent final report on the problem. Author (TAB)

N68-35571# Aerospace Corp., San Bernardino, Calif.
THE SUN AS A CALIBRATION SIGNAL SOURCE FOR L-BAND AND S-BAND TELEMETRY, OCTOBER 1967–MARCH 1968
W. R. Hedeman May 1968 29 p refs
(Contract F04695-67-C-0158)
(TR-0158(S3816-88)-2; SAMSO-TR-68-271; AD-672765)

A far field signal source is needed for frequent calibration of telemetry receiving stations in the L- and S-bands to insure proper station performance at all times. The sun provides sufficient signal strength in these bands, and its subtended angle of 0.5 deg from the earth is small enough to permit the calibration of the majority of telemetry stations. Solar observatories around the world are continuously measuring solar flux with an estimated error of less than 7 percent. If L- and S-band solar flux measurements were made available to telemetry stations through an essentially real time communications link the sun could be used as a signal source for calibration purposes. Characteristics of solar emission are reviewed briefly, and the methods of determining receiving system noise temperature are developed. Author (TAB)

N68-35572# Environmental Science Services Administration, Boulder, Colo. Research Labs.
PRELIMINARY INVESTIGATION OF BACKSCATTERING FROM RESONANT SIZE OBJECTS IN THE PRESENCE OF GROUND CLUTTER
Valdis V. Liepa 22 May 1968 44 p refs
(AFCRL-68-0293; SR-B-1; AD-672985)

Preliminary results are presented of an experimental study aimed at investigating techniques for detection of metallic objects of resonant size located on or near the ground. For the study, a short pulse L-band backscatter measurement system was chosen, and such system, capable of generating r-f pulses as short as 5 ns at 1.060 GHz, was constructed. The pulse transmission characteristics for various antennas were investigated and of these a monopole appeared to introduce minimum pulse distortion. Pulses 10 ns long were used, and the backscattering amplitudes were measured from half-wave resonant length wires as a function of their height above ground, and also as a function of the wire separation, when there were two of them. Judging from the results obtained thus far, backscatter amplitude measurements alone, however short the transmitted pulse may be, do not seem to provide sufficient information for recognition of metallic targets of resonant size. Phase and Fourier spectrum measurements should also be included. Author (TAB)

N68-35573# Michigan Univ., Ann Arbor. Radiation Lab.
NETWORK FUNCTION DETERMINATION FROM PARTIAL SPECIFICATION
Arthur R. Braun and E. Lawrence McMahon Jun. 1968 74 p refs
(Contract F19628-68-C-0071)
(AFCRL-68-0349; Rept.-1363-1-T; SR-1; AD-672987)

In certain problems of network theory the real and imaginary parts of a driving-point impedance function may be independently given in a band of interest leaving its continuations to zero and infinity completely unspecified. By manipulating the Hilbert transforms, relating the real and imaginary parts of a function of a complex variable (p = sigma + j omega) having no poles on the j omega axis or in the right-half plane, this report shows that if the continuations exist they are unique and readily obtained. Three necessary conditions for the existence of the continuations to the given parts (of the driving-point impedance function) are obtained. Further, if these three conditions are satisfied the continuations may be obtained as a Fourier series. Four known impedances were used as examples and their continuations determined. The results obtained were excellent. The agreement between the Fourier series solution (using the first six terms at most) and the exact expression was good up to the second significant figure. In the appendix a computer program which obtains the Fourier coefficients of the unknown continuations, from the given real and imaginary parts, is furnished. Author (TAB)

N68-35604# Kiruna Geophysical Observatory (Sweden).
VLF SIGNAL PHASE INSTABILITIES PRODUCED BY PROPAGATION MEDIUM—EXPERIMENTAL RESULTS
F. H. Reder (Inst. for Exploratory Res.) and S. Westerlund 22 Dec. 1967 75 p Presented at AGARD-EWP Symp. Phase and Frequency Instability in Radio Wave Propagation, Ankara, 9–12 Oct. 1967
(KGO-676) CFSTI: HC $3.00/MF $0.65

It is shown that utilization of the full potential of highly phase stable VLF signals in an undisturbed propagation medium requires a clear understanding of perturbations produced by transmitter and reception equipment. Next, signal phase instability is discussed for a quiet ionosphere in terms of diurnal and seasonal phase variations, and degrading effects due to mode conversion and mode interference. Phase instabilities during ionospheric disturbances have six primary sources: SID's affecting daytime phase at all latitudes; PCA's causing drastic and long lasting day- and nighttime phase advances on paths traversing the polar caps; relativistic electron precipitation at higher latitudes leading to moderate phase advances during several hours; aurorae affecting to some degree nighttime phase stability of VLF signals into or through the auroral zone; geomagnetic storms perturbing mostly the nighttime phase at all latitudes and leading occasionally to slow and moderate daytime phase advances along higher latitude paths; and unspecified disturbances altering the mode structure of some transmissions at night, thereby causing substantial phase fluctuations. Author

N68-35628# Kiruna Geophysical Observatory (Sweden).
CONTINUOUS MEASUREMENTS OF THE FARADAY EFFECT USING CROSSED ANTENNAE
A. Wernik Dec. 1967 16 p refs
(KGO-677) CFSTI: HC $3.00/MF $0.65

A possible method of recording the Faraday effect using crossed dipoles is presented. This enables continuous measurement of the orientation of the plane of polarization and also of its fluctuations to be made. Author

N68-35653# Telefunken G.m.B.H., Ulm (West Germany).
MINIATURIZED ANALOG-TELEMETRY-SYSTEM [MINIATURISIERTES ANALOG-TELEMETRIESYSTEM]
J. Schulze Munich Bundesmin. fuer wiss. Forsch. Jun. 1968 157 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-41) CFSTI: HC $3.00/MF $0.65

In order to transmit a small number of informations from missiles, especially the subcarrier frequency-modulation-system (FM/FM) is suitable. Each signal first is converted into voltage, the value of which then modulates the frequency of a subcarrier-oscillator. These oscillators have different zero-frequencies. The outputs of a set of oscillators become mixed and amplified

to a level suitable to drive a transmitter. The specifications correspond to the IRIG-standards. The airborne equipments like dc-amplifier, subcarrier-oscillator, wideband mixer-amplifier and power supply are designed for producing them in ceramic screening technology. The subcarrier-oscillator and the mixer-amplifier are already realized in this technology. Author

N68-35700# Kiruna Geophysical Observatory (Sweden).
ON THE SOLUTION OF THE INTEGRAL EQUATION RELATING HEIGHT DISTRIBUTION OF ELECTRON DENSITY TO RADIO WAVE ABSORPTION
Bengt Hultqvist Aug. 1967 16 p refs
(KGO-673) CFSTI: HC$3.00/MF$0.65

The integral equation relating radio wave absorption, $A(\omega)$, to electron density profile in the quasilongitudinal case was solved for the absorption coefficient according to classical magnetoionic theory. Explicit formulas are given for the electron density distribution as a polynomial in $\ln\nu$–which is very close to a linear function of height over a limited height interval–for the case when $(\omega \pm \omega_L) \cdot A(\omega \pm \omega_L)$ has been determined as a polynomial in $\ln(\omega \pm \omega_L)$ from the absorption measurements. A numerical example is discussed. Author

N68-35710# Telefunken G.m.B.H., Ulm (West Germany). Fachbiereich Anlagen Hochfrequenz.
INVESTIGATION ON THE POSSIBILITIES OF REDUCING ANTENNA NOISE TEMPERATURE AND SPILL-OVER RADIATION [UNTERSUCHUNG DER MOEGLICHKEITEN ZUR VERMINDERUNG DES ANTENNENRAUSCHENS UND DER RUECKSTRAHLUNG]
H. Besterda, P. Pruegel, and A. Schlaud Bad Godesberg Bundesministerium fuer wiss. Forsch. Jul. 1968 240 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-49) CFSTI: HC$3.00/MF$0.65

Several possibilities of reducing antenna noise with reflector antennas are described. The characteristic noise terms of an antenna are defined, and the various causes of antenna noise are discussed. Included is a description of theoretical and experimental studies on various types of hornfeeds which are particularly appropriate for feeding low-noise Cassegrain reflector antennas. The influence on the antenna noise temperature of various shielding means as well as of manufacturing inaccuracies is investigated. Author

N68-35736# Technische Hogeschool, Eindhoven (Netherlands). Afdeling Elektrotechniek.
AN ANTENNA FOR A SATELLITE COMMUNICATION GROUND STATION (PROVISIONAL ELECTRICAL DESIGN), 26 JANUARY 1967–SEPTEMBER 1967
J. Dijk, M. Jeuken, and E. J. Maanders Mar. 1968 125 p refs
(TH-68-E-01) CFSTI: HC$3.00/MF$0.65

Provisional electrical design of an antenna suitable for satellite communications in the frequency band of 3.700 to 4.200 Mc/s for receiving, and 5.900 to 6400 Mc/s for transmitting, is described. The properties of the cassegrain antenna are discussed, including noise, blocking, and diffraction problems. Analytical expressions are derived to calculate the decrease in antenna efficiency caused by blocking and diffraction. Diffraction effects at the subreflector are measured, and it is concluded that the angular aperture has no influence on the performance of the antenna. A theoretical discussion of the loss of energy due to blocking and a means to minimize this effect, by introducing some irregularities in the surface of the subreflector, are given. Feed patterns to be used in the final antenna system are shown. Analytical expressions and solutions for the shaped reflector systems are derived, and it is noted that low spillover losses and high aperture efficiencies can be obtained from these systems. Author

N68-35745*# ADCOM, Inc., Cambridge, Mass.
DEVELOPMENT OF ADVANCED DIGITAL TECHNIQUES FOR DATA ACQUISITION PROCESSING AND COMMUNICATION Interim Scientific Report
J. Levy and E. H. Gavenman 1 May 1968 95 p ref
(Contract NAS12-554)
(NASA-CR-86095; G-98; DO-C9) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Discussions of a design example of a Mars television mapping mission, the effects of additive noise upon correct quantization of an analog voltage, the frequency response characteristics of vidicons, the statistical characteristics of video data, and the distorting effects of systematic errors upon data are presented. A performance comparison of zero order, first order and second order picture compression techniques, with simulated compressed picture material is made. A theoretical analysis of various error control techniques to be used with compressed picture data sent over a noisy link is discussed. Simulated reconstructed pictures illustrate the effectiveness of the substitution approach. Author

N68-35746*# Harvard Univ., Cambridge, Mass. Engineering and Applied Physics Div.
ON OPTIMAL AND SUBOPTIMAL LINEAR SMOOTHING
R. K. Mehra Mar. 1968 34 p refs
(Grant NGR-22-007-068; Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005; N00014-67-A-0298-0008)
(NASA-CR-97072; TR-559; AD-669510) CFSTI: HC $3.00/MF $0.65 CSCL 09D

Recursive form of results on smoothing for linear dynamic systems is derived generally using the Orthogonality Principle of Linear Estimation. The form of the results is particularly useful for the sensitivity analysis of the optimal smoother. Explicit equations are derived for the actual covariance of a suboptimal smoother which uses wrong information about the mean square values of noise inputs. Conditions are established under which the calculated values of the covariances provide upper bounds on the actual covariances of the smoothed estimates. Author

N68-35767*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
RADAR SCATTEROMETER DATA VALIDATION, PHASE 1
Kenneth B. Craib Nov. 1967 107 p
(NASA-TM-X-61276; MSC-CA-R-67-3) CFSTI: HC $3.00/MF $0.65 CSCL 17I

Data generated by the 13.3-Ghz fan beam scattering radar for the Earth Resources Survey Program was reviewed to determine basic quality and suitablity for in-depth analysis. A total of 25 magnetic tapes recorded on Earth Resources Survey Program flight missions 21, 23, 29, 32, 35, and 36 were examined. Data and calibration signal samples were prepared together with a log that shows which runs met established standards and were acceptable for reduction purposes. Of the 70 flight data runs reviewed during the analysis, 46 were considered to contain reducible data. Author

N68-35783# Kiruna Geophysical Observatory (Sweden).
FARADAY ROTATION OBSERVATIONS USING A ROTATING ANTENNA
Ludwik Liszka and Andrzej Wernik (Polish Acad. of Sci., Warsaw) Dec. 1967 8 p ref
(KGO-678) CFSTI: HC$3.00/MF$0.65

An antenna uniformly rotating in the horizontal plane is discussed for observing Faraday rotation as might occur in cases where the polarization plane of satellite signals rotates slowly at high latitudes. The method is given for calculating the true amount of rotation for all Faraday nulls, beginning at the reference point and taking into account their signs. M.W.R.

N68-35837*# Aztec School of Languages, Inc., Acton, Mass.
INVESTIGATION OF ABSORPTION AND SCATTERING OF MILLIMETER WAVES IN PRECIPITATIONS. 1, 2 [DOSLIDZHENNYA VIRANNYA TA ROZSIIUVANNYA MILIMETROVICH CHVIL V OPADAX. 1, 2]
A. Ya. Usikov, V. L. Garman, and I. Kh. Vakser Oct. 1968 27 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 6, no. 5, 1961 p 618–641
(Contract NASw-1692)
(NASA-TT-F-11913) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Experimental data are presented on the damping of radio waves ranging in length from 8.15 to 2.7 mm in rain, and the basic results are given on a theoretical study of the absorption and scattering of millimeter radio waves in precipitations. The measurements were taken on short paths over a wide range of rain intensities, and data on the size of the drops was collected at the same time. The formulas presented permit calculation of the absorption and scattering of millimeter radio waves when the raindrop size distribution is known. Author

N68-35870# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FORMATION OF A RADIATION PATTERN OF RADIO INTERFEROMETERS BY THE FREQUENCY MULTIPLICATION METHOD [FORMIROVANIE DIAGRAMMY NAPRAVLENNOSTI RADIOINTERFEROMETROV METHODOM UMNOZHENIYA CHASTOTY]
A. E. Balklav 8 Sep. 1967 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk Latv. SSR, Ser. Fiz. i Tekhn. Nauk (Riga), no. 1, 1966 p 60–70
(FTD-HT-67-495; AD-673764)

The author derives expressions for calculating the directional pattern of an N-antenna radio interferometer if the instrument operates in frequency multiplication conditions. Frequency multiplication before and after interference is considered. Several examples are examined on the basis of the resultant general expressions. It is shown that frequency multiplication may be used to constrict the directional pattern of radio telescopes and radio interferometers. However, this does not always increase the resolution. Constriction of the pattern takes place on the n-th harmonic of the signal. The sensitivity is reduced in these cases since the n-th harmonic is attenuated in comparison with the first harmonic. The signal-to-noise ratio is reduced by the loss in sensitivity. From this standpoint, frequency multiplication after interference is more advantageous than before interference. TAB

N68-35903*# Houston Univ., Tex. Cullen Coll. of Engineering.
ADVANCEMENT OF THE GENERAL THEORY OF MULTIPLEXING WITH APPLICATIONS TO SPACE COMMUNICATIONS Final Report, May 1966–May 1968
R. D. Shelton 1 Jun. 1968 197 p refs
(Grant NGR-44-005-039)
(NASA-CR-97100) CFSTI: $3.00 CSCL 17B

Optimum orthogonal multiplexing systems based on derivation of selected orthonormal functions are investigated. Mathematical relationships are derived for message distortion due to time, frequency, and amplitude truncation. Computer programs to simulate the multiplexing systems on the IBM 7090 using DSL-90 simulation language are included. Orthogonal multiplexing theory is then applied to the solution of problems arising in systems such as the Apollo unified S-band communication system. General multiplexing and modulation design criteria for unified S-band systems are developed. The effects of random phase and timing errors on phase shift keyed (PSK) signal detection are studied and indicate phase errors to be more significant. Performance improvement of the PSK channel with random coding is discussed. D.H.B.

N68-35912*# Notre Dame Univ., Ind. Electrical Engineering Dept.
ANALYSIS OF DECODERS FOR CONVOLUTIONAL CODES BY STOCHASTIC SEQUENTIAL MACHINE METHODS
Thomas N. Morrissey, Jr. 1 May 1968 54 p refs
(Grant NGR-15-004-026)
(NASA-CR-97101; EE-682) CFSTI: HC $3.00/MF $0.65 CSCL 09D

Previous analyses of the error probability for feedback decoding of convolutional codes have focused almost exclusively upon the *syndrome portion* of the decoder, the contents of which are statistically dependent upon the infinite past due to the feedback of previous decoding estimates. In this paper the *entire decoder* is modeled as an autonomous stochastic sequential machine and finite Markov chain theory applied in order to obtain a precise expression for $P_{FD}(u)$, the probability of error associated with the feedback decoding of the u^{th} subblock of information digits, thus circumventing the problems imposed by the dependencies on the infinite past. The analysis technique developed here applies to any syndrome feedback decoder for a systematic, rate $R = K_o/N_o$ convolutional code of memory order m over GF(2), used for transmission over a binary symmetric channel. The stochastic sequential machine approach is also used in order to calculate the probability of error associated with semi-definite decoding, a decoding technique intermediate to feedback and definite decoding. Author

N68-35941# CBS Labs., Stamford, Conn.
DESIGN STUDY FOR RADAR LAND MASS SIMULATION SYSTEM Final Report, Feb.–Oct. 1967
Ivan H. Shim, Jon I. Wigby, and Alfred E. Mietzko May 1968 148 p refs
(Contract F33615-67-C-1400)
(AMRL-TR-68-8; AD-673908)

A design study and investigation to determine the requirements for the mechanical and electrical components of a Radar Land Mass Transparency System has been performed. The technique consists of moving a laser beam across a 122 cm square transparency to simulate the side-looking radar system of an aircraft. The most promising system of those considered from accuracy, complexity and cost considerations is shown to be a horizontally driven transparency with a vertically driven flying spot scanner. The spot, in its vertical heading, scans out a strip 5 cm wide. Spot size can be kept to 2.5 microns over the 5 cm scan length at any location on the transparency. Smoothness of motion to simulate an aircraft is achieved through a feedback control system designed to move at constant velocity. An overriding position loop will correct for any accumulated errors which could result from environmental or load condition changes. A position accuracy of plus or minus 0.00127 cm over the entire transparency is shown to be quite feasible. In addition, the speed range from low flying aircraft to satellites of approximately 100:1 is also shown to be feasible using the same system. Mechanical and electrical components chosen for performance calculations and tolerance determinations are off-the-shelf. These parts are easier to acquire and lower in cost than equivalent custom made components. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-34814 Washington Univ., Seattle.
THE APPLICATION OF SHIFT REGISTERS TO SECONDARY STATE ASSIGNMENT
Kenneth Herbert O'Keefe (Ph.D. Thesis) 1967 99 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-14203

This thesis introduces a method of synthesis of digital systems and develops a theory by which this new concept may be applied to problems of both theoretical and practical significance. The instrument chosen to illustrate the theory is a set of modules or building blocks, viz., shift registers of equal length. This module type has certain properties which are common to the general digital building block and therefore the development here represents a first step in obtaining a theory for system design using non-binary modules. An algorithm which determines whether or not an arbitrary sequential machine can be realized using a set of equal-length shift-register modules is developed. A state-assignment method, called multi-clock assignment, is introduced and developed which adds machine states such that realization at reduced speed is possible, and a bound on the speed reduction if found. It is shown that the development permits the addition of states by inspection such that when machine outputs are mechanized, logic is not required to detect the addes states. The new state-assignment method and its implication that no output logic is needed to detect added states are applicable to a large class of modules.
Dissert. Abstr.

N68-34933* Arizona Univ., Tucson. Analog/Hybrid Computer Lab.
A PDP-9 ASSEMBLY-LANGUAGE PROGRAM FOR THE FAST FOURIER TRANSFORM
S. A. Miller Apr. 1968 53 p refs
(Grant NsG-646)
(NASA-CR-96883; ACL-MEMO-157) CSCL 09B

The algorithm and a full printout are presented of a program for the efficient computation of the Fourier coefficients of a time series comprised of discrete data samples. The algorithm reduces the number of arithmetic operations required to transform a time series of $n = 2^n$ samples from N^2 to approximately $2N \log_2 N$ operations. Both computation time and round-off error are reduced by a factor of $(\log_2 N)/N$.
K.W.

N68-35005 Ohio State Univ., Columbus.
MAXIMAL MEMORY BINARY INPUT-BINARY OUTPUT SEQUENTIAL MACHINES
Monroe Merrill Newborn (Ph.D. Thesis) 1967 68 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 67-16320

Gill has shown that if a sequential machine with n states has finite memory μ then μ cannot exceed $(1/2)n(n-1) \triangleq N_n$. He has further shown that there exists an n state, N_n input-binary output machine with memory $\mu = N_n$ for every n. The question of whether a tighter upper bound might be placed on μ by the order of the imput alphabet was raised by Gill. Massey recently has shown that there exists a ternary input-binary output finite memory $\mu = N_n$ for every n. The primary purpose of this paper is to show that for every n there exists a binary input-binary output finite memory machine with memory $\mu = N_n$, and thus μ is shown not to be limited by the order of the input alphabet. It is shown that for every n, there are actually at least two different machines with memory $\mu = N_n$. It will also be shown that for every n, there exists a binary input-binary output finite memory machine with $\mu = N_n - 1$.
Dissert. Abstr.

N68-35027 Case Inst. of Tech., Cleveland, Ohio.
A COMPUTER-AIDED CONTROL TECHNIQUE FOR A REMOTE MANIPULATOR
Jon Terry Beckett (Ph.D. Thesis) 1967 146 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-16058

A technique for controlling a remote manipulator is investigated which utilizes a general purpose digital computer to assist the operator perform complex tasks with a miminum of information. An experimental computer-controlled manipulation system is described and several path and positioning control algorithms are presented. One position control algorithm minimizes the manipulator transit time and automatically directs the manipulator around all predefined obstacles. An executive program allows the operator to control the manipulator in the manual mode, to utilize a semi-automatic mode in which commands are centered through a teletype console, or to transfer control to an automatic mode executive routine which reads a series of commands from paper tape and automatically executes them.
Dissert. Abstr.

N68-35029 Case Inst. of Tech., Cleveland, Ohio.
AN OPERATIONAL DIGITAL COMPUTER EMPLOYING DECIMAL RATE MULTIPLICATION TECHNIQUES
Richard Barker Robrock, II (Ph.D. Thesis) 1967 206 p
Available from Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 67-16098

The general scheme of decimal rate multiplication (DRM) is presented, and numerous machines are investigated which implement this operation. It is shown that gating a DRM by an appropriate bidirectional counter permits digital integration by the summation of rectangles in an iterative fashion. The round-off errors associated with this process are discussed and a smoothing technique suggested for their reduction. The design and construction of the DRM-ODC, an operational digital computer employing the DRM integrator as a basic building block, is described and its potential applications investigated. Techniques are presented for the programming of this machine and are accompanied with numerous examples demonstrating its use in the solution of scientific and engineering problems as well as in the field of digital control.
Dissert. Abstr.

N68-35039 Northwestern Univ., Evanston, Ill.
SEARCH STRATEGIES AND RETRIEVAL LANGUAGES
Jacques F. Vallee (Ph.D. Thesis) 1967 161 p
Available from Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 67-15355

Properties of pushdown-store grammars applicable to the design of information retrieval automata are examined. For systems that accept natural language inputs there exists an efficient artificial language for the internal representation of the user's requests, namely the language of 'retrieval formulae.' Both a recognizer and a processor for these formulae are given. Implementation of a complete inquiry system using such an internal representation is studied with a star catalogue as its data base. Questions of a technical nature pertaining to the field of astronomical research are thus answered entirely by automatic means. An English text consisting of questions in machine-readable form is scanned by a CDC 3400 computer and analyzed semantically. The searching automaton yields the final numerical answers. On the basis of a series of observations of the behavior of this system, placed in linguistic environments of varying complexity, a theoretical representation of information retrieval automata is proposed in the case of sequential requests. The notion of 'generalized search strategy' is applied to these systems.
Dissert. Abstr.

N68-35064*# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
A DIGITAL PROGRAM FOR ON-LINE CORRELATION AND POWER SPECTRAL DENSITY ANALYSIS
E. R. Funke, F. T. Stock, and L. Groves Jan. 1968 98 p refs
(NRC-MK-23; NRC-10126) CFSTI: HC $3.00/MF $0.65

Procedures for the recording and analysis of analog data are summarized, and a technique for on-line correlation and spectrum analysis by means of a small digital computer with analog input and graphic output capability is described. This technique was programmed in FORTRAN II for an SDS 920. Emphasis was placed on ease of use by providing a man/machine dialogue. This program

is most suited to the analysis of analog signals in the sub-audio range. It is an example of the use of small digital computers as general laboratory instruments. Author

N68-35193*# Radio Corp. of America, Princeton, N. J.
MOS FIELD-EFFECT-TRANSISTOR TECHNOLOGY
J. T. Wallmark, W. A. Boesenberg, E. C. Ross, D. Flatley, and H. Parker Washington NASA Sep. 1968 67 p refs
(Contract NAS1-5794)
(NASA-CR-1113) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Integrated metal oxide semiconductor (MOS) circuit technology was studied as part of a laminated-ferrite memory project. The target was the development of a 64-transistor word-driver circuit, but the technology was also applied to a 100-transistor load circuit for the decoder. The developments included: (1) a contact metallization technique suitable for low temperature, low pressure circuit connections; (2) a circuit encapsulation and passivation technique compatible with the packaging and connection technique; (3) a high-density, long-life packaging technique; and (4) fabrication of long-life MOS transistors. Word driver strips with the expected performance and with acceptable yield were fabricated. A detailed account is given of silver contact stability, a key point in the circuit packaging. Also investigated were insulators for the gate region and the crossovers, gate healing techniques, and mask limitations on yield. Author

N68-35202# Hebrew Univ., Jerusalem (Israel).
DECOMPOSITION THEOREMS FOR FINITE SEQUENTIAL MACHINES
M. Magidor Feb. 1968 40 p refs
(Contract F61052-67-C-0055)
(TR-28; AD-673092)

In this work we present a different proof of results by K. B. Krohn and J. L. Rhodes ((1)), and give a new result on the same lines. These authors proved that every function computed by a finite state machines can be constructed by elementary operations on a set of prime functions. By extending the scope of elementary operations, we show that all functions computed by finite machines are built from a single function. Author (TAB)

N68-35250# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTIMUM SELECTION OF PARAMETERS FOR FERRITE-PAIR OPERATIVE STORAGES [OPTIMALNYI VYBOR PARAMETROV OZU S ISPOLZOVANIEM FERRITOVYKH PAR]
N. Ma. Damaskinskaya, I. K. Nosyrev, and V. A. Stepanov 12 Sep. 1967 12 p Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (USSR), no. 256, 1965 p 129–133
(FTD-HT-67-264; AD-672338)

The operative memory made of ferrite core pairs can operate reliably without temperature controls. The introduction and retrieval of information are carried out by current pulses the amplitude of which is not limited from above, and this results in a temperature independent operation. The principles of operations of ferrite pair units is discussed on a matrix example. The ferrite pair memorizes a single binary unit. The article presents all the pertinent relations and quotes theoretical results which indicate that normalized ferrite core pairs should secure reliable memory operation within the -60 to +60C range. The retrieval time is of the order of 10 microsec for cycling current pulses not exceeding 1.5A. Author (TAB)

N68-35263# National Bureau of Standards, Washington, D. C. Ccomputer Technology Section.
COMPUTER/DISPLAY INTERFACE STUDY Quarterly Report, 1 Jul.–30 Sep. 1967
Paul Meissner, Clayton A. Curtis, and Marshall D. Abrams Ft. Monmouth, N. J. Army Electron. Command Jul 1967 89 p
(ECOM-95844-5; QR-6; AD-673241)

The construction, wiring, and debugging of MAGIC II is continuing. The wire-wrap technique being used in MAGIC II, while very satisfactory electrically and from the standpoint of high density of connections, is quite demanding and is proceeding more slowly than anticipated. It is evidently much more suited to the use of automatic wiring. The development of function-generated circuits is continuing. Circuits for generating display lines and circles are being refined and more economical components are being investigated. Circuitry for interfacing the character generator to the logic circuitry is largely completed. Design of the circuitry for the display locator (cross-hairs) has been completed and breadboarding of this circuitry is in process. The light pen has been checked out using a laboratory oscilloscope. The report includes two papers considering the assembly language for the NBS CORD time-sharing system and a discussion of graphical languages and displays. Author (TAB)

N68-35278# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IMPROVING THE RELIABILITY OF PROGRAM INPUT UNITS [POVYSHENIYE NADEZHOSTI USTROYSTV VVODA PROGRAMMY]
G. M. Staroverov 13 Sep. 1967 13 p Transl. into ENGLISH from Mekhaniz. i Avtomatiz. Proizv. (Moscow), no. 4, 1966 p 35–36
(FTD-HT-67-284; AD-672911)

The article presents a theoretical investigation and an experimental verification of the effectiveness of an error-correcting code, proposed by the author for a system of programmed control of industrial machine tools. TAB

N68-35289# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF ELEMENTARY FUNCTIONS ON SETUN' [VYCHISLENIYE ELEMENTARNYKH FUNKTSIY NA MASHINE "SETUN"]
Ye. A. Zhogolev 14 Jul. 1967 38 p refs Transl. into ENGLISH from Univ. Vychislitel'nyy Tsentr. Sb. Rabot (Moscow), no. 3, 1965 p 509–535
(FTD-MT-66-164; AD-673194)

Algorithms for the calculation of elementary functions and their realization with the Setun computer are described. The computer itself was described in Zhurn. vychisl. matem. i matem. fiz. v. 1, No. 3, 1961. Standard subprograms are developed for addition, subtraction, subtraction of moduli, inverse addition, inverse subtraction, multiplication, division, extraction of square root, sine function, cosine function, exponential, and natural logarithm. Some peculiarities of programming, connected with the use of a ternary system in this computer, are discussed. The individual subprograms are described in detail. All the subprograms are intended to operate with the IP-2 interpreting program. The total computational error of each algorithm is analyzed in detail. TAB

N68-35317# Maryland Univ., College Park. Computer Science Center.
PICTURE PROCESSING BY COMPUTER
Azriel Rosenfeld Jun. 1968 312 p refs
(Contract Nonr-5144(00))
(TR-68-71; AD-672775)

The field of picture processing by computer is reviewed from a technique-oriented standpoint. Only the processing of given pictures (as opposed to computer-synthesized pictures) is considered. Specific areas covered include: (a) Pictures as information sources and their efficient encoding; (b) Approximation of pictures - sampling and quantization techniques; (c) Position-invariant

operations on pictures and their implementation (digital, electro-optical, optical); applications to matched filtering (template matching), spatial frequency filtering and image restoration, measurement of image quality, and image enhancement (smoothing and sharpening); (d) Picture properties (linear; local and textural; random) useful for pictorial pattern recognition; (e) Figure extraction from pictures; figure properties (topology, size, shape); (f) Picture description and picture languages. Author (TAB)

N68-35332# Stanford Univ., Calif. Dept. of Computer Science.
THE FORMAL THEORETIC ANALYSIS OF STRONG EQUIVALENCE FOR ELEMENTAL PROGRAMS
Donald M. Kaplan Jun. 1968 270 p refs
(Contract ARPA SD-183)
(CS-101; AI-MEMO-60; AD-672923)

The syntax and semantics is given for elemental programs, and the strong equivalence of these simple ALGOL-like flow-charts is shown to be undecidable. A formal theory is introduced for deriving statements of strong equivalence, and the completeness of this theory is obtained for various sub-cases. Several applications of the theory are discussed. Using a regular expression representation for elemental programs and an unorthodox semantics for these expressions, several strong equivalence detecting procedures are developed. Author (TAB)

N68-35336# Illinois Univ., Urbana. Dept. of Computer Science.
THE LOGICAL DESIGN OF A CLASS OF LIMITED CARRY-BORROW PROPAGATION ADDERS
Richard T. Borovec (M.S. Thesis) 1 Aug. 1968 39 p refs
(Contracts AT(11-1)-1018; NSF GP-4636)
(COO-1018-1152; Rept.-275; AD-673258)

It has been recognized for some time that one of the ways of increasing the speed of arithmetic operations in a digital computer is to introduce redundancy into the arithmetic unit, i.e. using k digital values in radix r where $k > r$. The purpose of this thesis is to determine the logical structure of a class of redundant adders which allow both the addend and the augend to be expressed redundantly. Rohatsch has shown that such adders must consist of three levels, i.e. three transformations are necessary to map the input digit set onto the output digit set. Author (TAB)

N68-35341# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF MAINTAINABILITY OF ELECTRONIC DIGITAL COMPUTERS [VOPROSY REMONTOPRIGODNOSTI ELECTRONNYKH TSIFROVYKH VYCHISILITELNYKH MASHIN]
M. A. Titov, L. V. Surkov, and S. R. Ivanov Dec. 1967 15 p refs Transl. into Vychisliter'naya Tekhn. (Moscow), no. 5, 1966 p 201–210
(FTD-MT-24-338-67; AD-672709)

In the overall digital computer reliability estimates the repairability factors such as the detection, removal, and prevention of failures must be included in the analysis. These in turn do not depend on the computer system organization above, but also on the capability of the maintenance personnel. The design of a computer system with a specific repairability figure is difficult since the statistical data for the new system is not available a priori. The authors make an attempt to correlate certain experience gained during the operation of a Ural-2 computer with the repairability design parameters for inclusion in future designs. Thus, the computer availability time is related to the mean restorability time which in turn is shown to depend on a number of factors: computer functional organization (i.e. whether provisions are made for executing test programs), amount of equipment redundancy and built in control circuitry, location of fault indicators, structural organization (i.e. whether the structure is modular and access to measuring and test equipment is easy), organization of maintenance routines and schedules, and the qualification of maintenance personnel. Author (TAB)

N68-35363# California Univ., Los Angeles. Dept. of Engineering.
A COMBINATIONAL ARITHMETIC FUNCTION GENERATION SYSTEM
Chin Tung Jun. 1968 225 p refs
(Contracts Nonr-233(52); ARPA SD-184)
(Rept.-68-29; AD-672586)

The continuing reduction of the size and cost of microelectronic logic elements encourages the utilization of more complex logic nets in digital computers. In arithmetic processors, because of the application of these complex logic nets, the replacement of sequential logic nets by their combinational equivalents and the substitution of programmed software subroutines by hardware function generators are to be economically justified in the near future. The kernel of this combinational function generation system is embodied in the design of a single building block and the specification of combinational arithemetic nets. This building block is designed at the arithmetic level, employing the redundant signed-digit number system, in order to take full advantage of the complexity offered by microelectronics on a single chip. A combinational arithmetic net, composed of an acyclic array of the arithmetic building block, is oriented in such a fashion that a given function can be approximated with accuracy, cost, and speed adjustable. An economic alternative to this locally combinational arithmetic net is the pipelined combinational arithmetic net which is composed of a totally combinational arithmetic subnet and a sequential subnet with feedback loops introduced. The pipelined combinational arithmetic net is found to be particularly suitable for evaluating chebyshev series which is an important approach to approximating a wide variety of functions. TAB

N68-35405# Stanford Research Inst., Menlo Park, Calif.
HIGH INFORMATION DENSITY STORAGE SURFACES Quarterly Report, 1 Jan.–31 Mar. 1968
Louis Heynick Jul. 1968 41 p refs
(Contract DA-28-043-AMC-01261(E))
(QR-12; ECOM-01261-12; AD-673143)

Progress is described on a program devoted to the preparation and investigation of two novel kinds of electron-beam-addressable storage elements of submicron size and densely packed arrays of these elements, and to the construction of a large-capacity, high-speed, electron-beam-addressable, data-storage system utilizing regular arrays of these elements. Further work on poly(methyl methecrylate), and electron-sensitive material that exhibits both positive- and negative-resist behavior, is discussed leading to a basic procedure for utilizing this material to advantage in storage mosaic formation. A new technique for exposing positive resists in regular patterns of high packing density over large areas is described. This technique is based on the use of a fine-mesh screen as a corresponding array of local electron lenses. Recent developments of aluminum-oxide etching with vaporized lead fluoride (PbF2) are covered, including the use of RF for ameliorating the unwanted etching of molybdenum resist perimeters surrounding the alumina film areas. First results of storage and readout on regular arrays of micro-cap elements are presented. Further development of a computer program for the design of electron-optical systems capable of scanning 100,000,000 elements per field for storage mosaic address is discussed. Author (TAB)

N68-35424# System Development Corp., Santa Monica, Calif.
ABSTRACT FAMILIES OF LANGUAGES
Seymour Ginsberg and Sheila Greibach 19 Mar. 1968 64 p refs Presented at 8th Ann. Symp. on Switching and Automata Theory, Tex. Univ., 19 Oct. 1967 Revised

(Contract F19628-67-C-0008; Grant AF-AFOSR-1203-67)
(TM-738/044/00; AFCRL-68-0240; SR-17; SR-5; AD-672971)

The notion of an abstract family of language (AFL) as a family of sets of words satisfying certain properties common to many types of formal languages is introduced. Operations preserving AFL are then considered. The concept of an abstract family of acceptors (AFA) is also introduced and shown to give rise to an AFL. A necessary and sufficient condition on an AFL is presented in order that the AFL come from some AFA. Finally, abstract families of transducers (AFA with output) are discussed. Author (TAB)

N68-35460# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS: RECENT NEWS ITEMS, NUMBER 19
Dorothy McDonald Jul. 1968 73 p
(P-3600/19; AD-672949)

Contents: Specifications for various digital computers; Socialist countries cooperate in computer production; Five new computer centers in operation; A. I. Berg on cybernetics; Automated hybrid computer system developed; Achievements of Armenian Power Engineering Institute; Economic forecasting and cybernetics; Computers taught to understand human speech; Technical cybernetics research at five institutes; Research plans of the Ukrainian Academy of Sciences; and Computers used in gold prospecting. TAB

N68-35462# Fleet Operations Control Center, Pacific Fleet, San Francisco, Calif.
JOVIAL PROCEDURE LIBRARY
Apr. 1968 149 p refs
(FOCCPAC-TN-3; AD-672933)

This document represents the first attempt to assemble, in a single volume, all the various descriptions (written or verbal) of the routines on the JOVIAL Procedure Library at FOCCPAC. Author (TAB)

N68-35476# Union Carbide Nuclear Corp., Oak Ridge, Tenn. Computing Technology Center.
DSED, A DATA SET EDIT PROGRAM AND MIGHTY MOUSE SUBPROGRAM
Alfred A. Brocks 24 Jun. 1968 101 p
(Contract W-7405-ENG-26)
(K-1748) CFSTI: HC $3.00/MF $0.65

The Data Set Edit Program and the set of subroutines used to process data for All Mighty Mouse master tapes are described. The IBM 360 FORTRAN program is suitable for reducing and managing data which refers to an individual and which consists of several subtopics. The master data sets are constructed of self-describing records stored sequentially by the individual serial (identification) number. The records may be of variable content and variable structure as long as the basic underlying rational of the record format is retained. The master data set is intended for use in a subsequent sequential, conditional search and analysis program. The program contains capabilities to update, correct, delete and erase records or subtopics as well as to provide lists of various types, pooled data sets and a transaction log of all activity. The calling program is general and is made specific to any problem by the use of subroutines. The application to low level radiation data on mice is described. This report consists of the following sections: a description of the Data Set Edit Program, the specifications of the subprograms required to process data for the All Mighty Mouse master tapes, (including the pathology dictionary update program), a User's Guide and Setup Instructions, program lists of the main program and all subroutines including a skeletal input/output subprogram, and, sample input data. Author (NSA)

N68-35510# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INCREASED CAPACITY MEMORY UNITS WITH UNIPOLAR INFORMATION RECORDING [ZAPOMINAYUSHCHYE USTROYSTVA POVYSHENNOY YEM KOSTI S UNIPOLYARNOY ZAPISIYU INFORMATSII]
I. V. Eremenko and V. B. Smirnov 24 Jan. 1968 14 p Transl. into ENGLISH from the Russian
(FTD-MT-24-7-68; AD-672713)

The feasibility of increasing the capacity of magnetic memories with mobile information carriers is discussed. The mere ei enlargement of the capacity must also be followed by an increase in the number of autonomous input and output information channels and a decrease in the energy needed for the recording of one bit of information. Among other aspects, the article discusses increases in drum width, describes briefly the unipolar principle for recording and reading of information, and presents a preliminary calculation and modeling of the magnetic circuit of a new magnetic head (remagnetization is carried out by the basic magnetic flux and not by the stray field). While the recording head of the 'Ural-1' computer requires 6.3 mw of power for the recording of one binary sign, the newly designed heat for unipolar registration requires only approximately .002 mw to do the same job. On the other hand, as a result of a reduction from 1 to 0.01 sq mm in the area needed for the registration of one pulse, the capacity of the proposed drum is 200 times the capacity of the existing 'Ural-1' drum. TAB

N68-35554# Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires.
PROGRAMMER FOR AUTOMATIC GAMMA SPECTROMETRY [ORDONATEUR DE SEQUENCE POUR SPECTROMETRIE GAMMA AUTOMATIQUE]
Robert Romanetti (Ph.D. Thesis – Aix-Marseille Univ., France) Apr. 1968 44 p refs In FRENCH
(CEA-R-3452)

With this apparatus, which is constructed of logical integrated circuits, it is possible both to synchronize an automatic gamma spectrometry assembly and to record the spectra on punched cards. An IBM terminal will make it possible with the help of analysis by the least squares method and by a direct dialogue with an IBM 360 computer to obtain analytical results almost instantaneously. Author

N68-35560*# Autonetics, Anaheim, Calif.
STUDY OF SPACEBORNE MULTIPROCESSING–PHASE 2. VOLUME 2: TECHNICAL DESCRIPTION Final Report
L. J. Koczela Washington NASA Sep. 1968 391 p refs
(Contract NAS12-108)
(NASA-CR-1159; C6-1476.22/33, v. 2) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Results are presented on a research study of an advanced multiprocessor computer organization for future space missions. The organization is entitled the "Distributed Array Memory and Processor" computer. A manned Mars lander mission was selected as a representative mission for application and the computer requirements were developed. The organization developed utilizes an array of cells capable of a high degree of computational parallelism. The feasibility of such cells is dependent upon future large scale integration technology. Research was carried out in the hardware design and software analysis of this organization. Author

N68-35580# Montana State Coll., Bozeman. Engineering Research Labs.
CELLULAR REALIZATION OF THE DYNAMIC PROGRAMMING ALGORITHM Annual Progress Report
Robert C. Minnick and Donald A. Rudberg Apr. 1968 24 p refs

(Contract N00014-67-C-0477)
(Rept.-603-F1-0468; AD-672570)

General algorithmic specification, not including detailed logical design, of a highly parallel, specially organized cellular machine to embody a discrete Kalman filter is described, various matrix operation algorithms and comparisons to sequential operations are given, parallel computation is based on a square array of identical, limited capability modules, providing inherent speed and taking advantage of current LsI technology. The time to process increases about linearly with problem size rather than as the cube. simulation results of a tracking problem posed by Naval Electronics Laboratory, San Diego, are included, the problem is one of a linear plant with a nonlinear observation, thus a dynamic linearization of the observation matrix is required. Such dynamics pervading the entire filter. Author (TAB)

N68-35582# System Development Corp., Santa Monica, Calif.
CHECKING AUTOMATA AND ONE-WAY STACK LANGUAGES
Sheila Greibach Apr. 1968 36 p refs
(Contracts F19628-67-C-0008; AF-AFOSR-1203-67)
(SDC-TM-738/045/00; SR-18; AFCRL-68-0241; AD-672970)

A checking automaton is equivalent to a one-way nonerasing stack automaton which, once it enters its stack, never again writes on its stack. The checking automaton languages (cal) form a full AFL (Abstract Family of Languages) closed under substitution. If L is contained in a^* is an infinite cal, then L contains an infinite regular set. Consequently, there are one-way nonerasing stack languages which are not cal. Author (TAB)

N68-35623 National Lending Library for Science and Technology, Boston Spa (England).
HIGH-SPEED COMPUTERS IN PHYSICAL RESEARCH [BYSTRODEISTBUYUSCCHIE BYCHITEL'NYE MASHINY B FIZICHESKIKH ISSLEDOBANIYAKH]
M. G. Meshcheryakov and N. N. Govorun [1968] 13 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 3, 1968 p 14–23
Available from Natl. Lending Library, Boston Spa, Engl.

Problems and procedures involved in the use of high speed computers in physical research are discussed, with specific attention given to the automatic processing of photographic records of the tracks of nuclear particles. Various systems for processing films from bubble chambers are noted, and use of computers on a real-time scale in physical experimentation is reviewed. Computer techniques in low energy nuclear research are noted, as the mathematical provisions associated with computer technology. M.W.R.

N68-35627*# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
A STUDY TO DETERMINE AN EFFICIENT DATA FORMAT AND DATA SYSTEM FOR A LIGHTWEIGHT DEEP SPACE PROBE
W. Higgins, T. Baker, S. Bigelow, E. Cohler, and J. Glass Feb. 1968 248 p refs
(Contract NAS2-3255)
(NASA-CR-73211) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A system simulation model for the central data system of a scientific space probe has been designed and programmed. The goal has been to define the basic and ancillary services that the central computer can provide the experimenters. The instrument complement assumed for the simulation consists of a triaxial magnetometer, cosmic ray telescope, neutron detector, radio propagation experiment, plasma probe, micrometeorite detector, and a VLF experiment, which measures the temporal correlation of the very low frequency electric and magnetic fields. Engineering data inputs are simulated and processed. The data sampling requirements and operational modes of the experiment are known precisely. The interface between the central computer and the experiments is influenced by instrument design and postulated solar phenomena. Simulation model ground commands specify the instrument operating modes, execution of specific processing algorithms, priority telemetry subcom, telemetry rates and formats, and parameter values. The optional processing subroutines include quantiles, histograms, spectral analysis, digital filtering, mean and variance, and zero order prediction. Author

N68-35770*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE PLASMA STATISTICS COMPUTER ABOARD EXPLORER 34
David H. Schaefer and James W. Snively, Jr. Oct. 1967 33 p refs
(NASA-TM-X-63339; X-711-67-520) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A computing device that calculates quantities related to the mean, variance, and mode of the distribution of plasma as a function of the azimuthal angle of the spin stabilized satellite is aboard Explorer 34. The device uses a combination of integrated circuits and discrete components including tunnel diodes. Performing computations aboard the spacecraft and telemetering the results of the calculations allows about twenty times more data to be sent than if the collected histograms were directly transmitted. Author

N68-35868# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TABLE MODEL OF AN ELECTRONIC, KEY-OPERATED COMPUTER [NASTOLNAYA ELEKTRONNAYA KLAVISHNAYA VYCHISLITELNAYA MASHINA]
A. M. Shauman and M. K. Chirkov 25 Aug. 1967 13 p refs Transl. into ENGLISH from Vychisliter'naya Tekhn. i Vopr. Programmirovaniya (Moscow), no. 1, 1962 p 3–10
(FTD-HT-67-36; AD-673823)

Article enumerates the basic requirements for a table model electronic computer. Such a model has been produced by the computer center of Leningrad State University imeni A. A. Zhdanov. Article explains its operating principles and provides a circuit layout. TAB

N68-35874# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
FORTRAN 2-FORTRAN 4 CONVERSION OF METHUSELAH
K. H. van Klink May 1968 43 p refs
(AAEC/TM-455)

The processes involved in translating an IBM 7090 FORTRAN 2 program, Methuselah II, to an IBM 360-50H FORTRAN 4 program are described. The program has its own comprehensive nuclear data library and may be used to calculate cell reactivity and burnup for a very wide range of liquid moderated reactors. It is particularly valuable for broad-range nuclear performance surveys. Problems which had to be overcome in the translation of Methuselah included language differences, machine differences and operating differences. These differences are detailed and thorough description of data preparation as required with the 360-50H is included. Author (NSA)

N68-35878# California Univ., Livermore. Lawrence Radiation Lab.
COMPUTER-AIDED CIRCUIT LAYOUT AND DESIGN
L. C. Martin Jan. 1968 18 p refs Presented at 5th Ann. Design Automation Workshop Conf., Washington, D. C. 1968
(Contract W-7405-ENG-48)
(UCRL-70910; CONF-680707-1) CFSTI: HC $3.00/MF $0.65

The general features of PUZZLE, FORTRAN 4 program for the design and layout of electronic circuits, are described. NSA

N68-35880# RAND Corp., Santa Monica, Calif.
THIRD-GENERATION COMPUTER TRENDS
B. W. Boehm Aug. 1968 16 p refs Presented at Joint Eng. Management Conf., Philadelphia, 30 Sep. 1968
(P-3903; AD-673830)

This report describes some of the prospects for third-generation computers, and also points out some of the problems and pitfalls. It discusses the problem area to which engineering managers can contribute most effectively: the inadequate feedback in the process of developing and using computer systems. Author (TAB)

N68-35882# RAND Corp., Santa Monica, Calif.
THE 360/65: RAND'S NEXT COMPUTER
G. D. Brown Aug. 1968 12 p Presented at Computer Sci. Dept. Seminar, Santa Monica, Calif., 9 Jul. 1968
(P-3892; AD-673827)

This paper describes some of the hardware and software that will come with the 360/65 computer and explains what the installation of this new computing system will mean to users. Author (TAB)

N68-35883# Stanford Research Inst., Menlo Park, Calif.
GRAPHICAL-DATA-PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION Quarterly Report, 1 Mar.–31 May 1968
R. O. Duda and P. E. Hart Aug. 1968 34 p refs
(Contract DA-28-043-AMC-01901(E))
(ECOM-01901-31; QR-9; AD-673719)

In this report a largely self-contained summary of our work on context analysis is given for the final detection and correction of character-classification errors. The context-analysis techniques are embodied in a LISP program called the context-directed analyzer, which emphasizes FORTRAN statement identification, identifier-table construction, and statement analysis. Author (TAB)

N68-35895# Worcester Polytechnic Inst., Mass.
STUDY OF ON-LINE DATA ANALYSIS WITH A HYBRID COMPUTER Final Report, 1 Sep. 1967–31 May 1968
Owen W. Kennedy, Jr., Donald C. Eteson, Romeo L. Moruzzi Jul. 1968 56 p
(Contract F19628-68-C-0040)
(AFCRL-68-035C; AD-673902)

Hybrid Computer programs were developed to accept data in analog form and simultaneously to perform selected analysis and reduction procedures in real time, the results appearing as continuous analog outputs. Analog circuits with parallel logic removed interference spikes from the original data, separated the frequency components of the signal using analog band-pass filters, measured the power in these frequency bands, and formed a continuous record of the correlation coefficient of two signals. Hybrid programs calculated, and outputed in analog form, the amplitude probability density and the auto- or crosscorrelation functions; initial data conditioning and final display utilized analog circuits, but the calculation was performed on a digital computer linked by a-d and d-a converters and control circuits. Author (TAB)

N68-35939*# Bellcom, Inc., Washington, D. C.
FUTURE SPACEBORNE MEMORIES WITH 10^3–10^7 BIT CAPACITIES
B. W. Kim 26 Jul. 1968 16 p refs
(Contract NASw-417)
(NASA-CR-97075; TM-68-1031-4) CFSTI: HC $3.00/MF $0.65
CSCL 09B

Weight, volume and power consumption of small (10^3–10^7 bit capacity) digital storage units are estimated for the 1970–1972 period. Computations are for memories with $\leq 2\mu$ sec. cycle time. Lower powers can be obtained at the expense of speed and the various other parameters. Curves are included in the memorandum that show the variations among volume, weight, capacity, power, speed, and choice of technology. Technologies considered include laminated ferrites, planar thin films, plated wires, metal–oxide–silicon (MOS) integrated circuits, ferrite cores and tape recorders. All of these except MOS integrated circuits retain stored information if power is cut, i.e., they are nonvolatile. Author

N68-35949# California Univ., Livermore. Lawrence Radiation Lab.
PARAMETRIC VARIATION OF ASTRON VARIABLES
P. B. Weiss and M. Brettschneider 29 Dec. 1967 11 p refs Presented at the Ann. APS Meeting, Div. of Plasma Physics, Austin, Tex., 8–11 Nov. 1967
(UCRL-70675; CONF-671132-2) CFSTI: HC $3.00/MF $0.65

Several modifications and extensions of a one-dimensional computer code called RESIST, originally developed by Neil and Heckrotte have been undertaken. The purpose was to develop a computer model of the Astron with which "experiments" such as parametric variation of those variables of significance to the machine might be undertaken. In this code, the electrons are confined in a fixed plane between two conducting surfaces with a resistive plane placed appropriately. The calculation assumes the axial velocity of electrons is much less than c, and numerically integrates the Vlasov equation to give the particle distribution in z–v_z phase space. The parameters recently studied have included the surface resistivity of the resistive wall, and the injection energy for several different injection currents. NSA

N68-35970# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROBLEM OF PATTERN RECOGNITION [O PROBLEME OPOZNANIYA KONFIGURATSII]
V. I. Varshavskii and V. A. Sokolovskii 18 Sep. 1967 21 p refs Transl. into ENGLISH from Nauchn.-Tekhn. Obshchestva Radiotekhniki i Elektrosvyazi SSSR (Moscow), 1962 p 12–26
(FTD-HT-67-444; AD-673785)

The problem of pattern recognition is examined along two directions. The first direction consists of a group of problems related to constructing reading devices consisting of comparators and a large memory. A characteristic of reading devices is the inability to change their mode of action during the operating process. This leads to a study of the second direction of the problem of pattern recognition which concerns the question of constructing learning recognition devices. Learning recognition devices are automatic machines with feedback, that is, devices which compare the responses for the input patterns with the responses for an external device (an amplifier). The problem of pattern recognition is also reported in terms of discrete automatic machines, that is, devices having a finite number of inputs, a finite number of outputs and a finite number of internal conditions. The automatic machine obtains information about the external medium by its sensing elements, which (in the case of living organisms they are called receptors) serve as inputs to the automatic machine. The external medium is reflected in the automatic machine through the conditions of its inputs. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-34815 Lehigh Univ., Bethlehem, Pa.
NOISE IN VARACTOR MULTIPLIER SOURCES
John George Ondria 1967 147 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-14947

Noise measuring systems for S, X, and Ku-bands were designed to obtain high sensitivity at spectral frequencies from 1 Hz to 30 MHz off the carrier. They were used to measure the noise properties of different microwave sources and arrive at comparisons. Results reveal that AM noise is lowest in crystal-controlled solid-state sources and klystrons. The noise level in these two sources is about equal. The major source of AM noise below 100 kHz from the carrier is due to low frequency flicker noise modulation of the carrier. At spectral frequencies below 100 kHz off the carrier, crystal-controlled solid-state sources are considerably better beyond this range. A proposed technique of neutralization of the oscillator crystal wafer capacitance improves the FM noise by a factor better than five in the video range form 1 kHz to 10 Khz off the carrier. Its minimum value closely approximates the theoretically predicted order of magnitude. It was possible to extend the useful video range of the multiplier sources by improving their noise figures. The internal noise contributions of properly designed multiplier varactor stages were found to be essentially negligible. Filters within the VHF driver proved effective in reducing noise only when located after the final power amplifier stage. Dissert. Abstr.

N68-34841# Royal Aircraft Establishment, Farnborough (England).
COMPUTER AIDED CIRCUIT DESIGN. ANALYSIS OF DISTRIBUTED NETWORKS
P. McMahon Mar. 1968 19 p refs
(RAE-TR-68057; AD-835704) CFSTI: HC $3.00/MF $0.65

A general purpose computer analysis programme for distributed electrical networks is described. Applications to analysis of microelectronic circuits are given as examples of the use of the programme. The programme is written in Mercury Autocode and is applicable to two port networks. Author (TAB)

N68-34972 Ohio State Univ., Columbus.
NOISE INDUCED GAIN SATURATION IN THE ULTRASONIC TRAVELING WAVE AMPLIFIER
James Towers Hanlon (Ph.D. Thesis) 1967 73 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 67-16285

A strong coupling exists between traveling acoustic waves and drifting electrons in piezoelectric semiconductors which allows the acoustic waves to be greatly amplified. A definite relationship has been established between a pronounced departure from small signal theory gain, the onset of nonohmic current voltage characteristics, and gain saturation on broad banded acoustic noise flux in such a cadmium sulfide ultrasonic amplifier. Noise figure measurements in material whose experimental gain behaves according to small signal theory have allowed the evaluation of the net level of acoustic noise flux at the amplifier output plane when noise saturation occurs. Extrapolation from measured points yields a relationship between the acoustic flux saturation level and the material carrier concentration. Further measurements also indicate that, even for noise flux levels approaching saturation, signal saturation occurs for bunching parameters slightly greater than unity. Dissert. Abstr.

N68-35121# Fairchild Semiconductor Corp., Mountain View, Calif.
SOME GUIDELINES FOR THE SELECTION OF LOW NOISE TRANSISTORS
Richard T. Westlake *In* Calif. Univ. Noise Reduction Conf. [1968] p 21-35 refs (See N68-35118 22-23)

The improvement in transistor parameters, coincident with improved 1/f noise performance, makes it necessary to re-examine the criteria employed in low frequency A.C. amplifier design. The variations of low frequency noise figure with operating point and the interrelationships of other relevant transistor parameters are presented. The effects on biasing, gain, and bandwidth for a transistor with reduced 1/f noise are demonstrated by recognizing the transistor parameter correlations which exist. Author

N68-35122# Dickson Electronics Corp., Scottsdale, Ariz.
NOISE GENERATION AND REDUCTION IN ZENER DIODES
David W. Hutchins *In* Calif. Univ. Noise Reduction Conf. [1968] p 36-63 refs (See N68-35118 22-23)

The word zener is used in this report to identify voltage regulator and reference diodes rather than define the field effect phenomenon associated with a P-N junction. The character of noise is investigated using practical analyses of standard devices. Noise generated in zener diodes is classified into four types which all occur under a reverse bias condition. Analysis of noise with current, temperature and frequency is presented for both alloy and diffused junctions. DC instability (noise) is discussed with high stability zeners and is characterized by very slow fluctuations in zener voltage. Zener diodes with the lowest noise figure are obtained by reducing defects during semiconductor fabrication. Author

N68-35137# Genistron, Inc., Los Angeles, Calif.
GETTING "THE MOST" FROM FILTERS
J. F. Fischer, Jr. *In* Calif. Univ. Noise Reduction Conf. [1968] p 225-234 refs (See N68-35118 22-23)

The theoretical design of filters is a well developed and reasonably understood subject, however, the practical utilization of these devices still leaves something to be desired. Rather than consider such design items on the internal components, only a selected number of parameters affecting the real life effective use of noise filters are considered in the following discussions. Items discussed include: insertion loss, terminating source and load impedances, transient responses, isolation of input and output terminals, volt drop at power frequencies, current capability and heat rise, and grounding and bonding. Author

N68-35259# Fairchild Semiconductor Corp., Mountain View, Calif.
RADIATION STUDY OF MOS STRUCTURES
E. H. Snow, H.-P. Albus, S. F. Cagnina, A. R. Molozzi, and D. J. Fitzgerald Jul. 1968 34 p refs
(Contract AF 19(628)-5747)
(AFCRL-68-0321; SR-5; AD-672264)

The effects of neutron irradiations on junction field-effect transistors have been studied both experimentally and theoretically. A computer program has been written to calculate JFET characteristics including the effects of carrier removal. It has demonstrated that calculated and experimental characteristics agree well both before irradiation, and after doses of up to 10 to the 15th power nvt. Devices have been fabricated with 10 to the 17th power/cc channel doping which show less than 15% change in I sub DSS or G sub M after 10 to the 15th power NVT thus demonstrating the feasibility of a JFET resistant to the permanent effects of nuclear as well as ionizing radiation. Drift tests on LI doped MOS capacitors and gate-controlled diodes have revealed gross instabilities with complicated time and voltage dependences. It is believed that the migration of LI(+) ions in the surface depletion region as well as in the oxide is involved. Author (TAB)

N68-35292# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON MULTIPLIER KLYSTRONS WITH TRAVELLING WAVES [OB UMNOZHITEL'NYKH IKLISTRONAKH S BEGUSHCHEV VOLNOY]

A. D. Sushkov 30 Jun. 1967 17 p refs Transl. into ENGLISH from Elektrotekhnicheskiy Inst. (Leningrad), no. 048, 1963 p 66–75
(FTD-MT-67-16; AD-673171)

The operating principle of the described klystrons is based on the interactions between an electron beam and traveling electromagnetic waves in wave guides. This interaction makes possible velocity modulation of the electron beam and the extraction of high-frequency power from the system. The simplest wave guide multiplier klystron and its operation are illustrated. Such a klystron has the advantage over ordinary klystrons in that its bandwidth is considerably greater. The frequency can be tuned either by varying the phase velocity of the exciting current wave or by varying the phase velocity of a given mode of the electric field. Equations are derived for the output power and the efficiency of such a klystron and it is shown that by using periodic loading it is possible to raise the efficiency from 35 to 50%. A modification of the double-wave guide klystron, namely a klystron with annular wave guides is also discussed. Such a klystron has the same efficiency as an ordinary klystron, but since the frequency and oscillation mode are independent of the diameter of the annular wave guides employed, the klystron can be made up of large wave guides and accommodate more powerful electron beams. TAB

N68-35293 National Lending Library for Science and Technology, Boston Spa (England)
ACTIVE CIRCULATORS
B. Pellegrini 5 Sep. 1968 19 p refs Transl. into ENGLISH from Alta Frequenza (Milan), v. 36, no. 6, Jun. 1967 p 529–537
(TRANS-2476) Available from Natl. Lending Library, Boston Spa, Engl.

Two systematic methods for the design of low-frequency circulators are discussed. In the first method active, bilateral, non-reciprocal quadripoles are used, in either delta or star formation. In the second method the "circularity" is obtained by means of unilateral quadripoles and directional couplers. In this case a transmission efficiency greater than unity is obtained, as well as a considerable degree of stability of isolation. For the circulators of the second type with active directional couplers, the dependance of the efficiency and isolation on the frequency is calculated. The experimental results confirm the analytical expectations. Author

N68-35299# TRW Systems, Redondo Beach, Calif.
INVESTIGATION OF RADIATION HARDENED CIRCUIT ELEMENTS
Larry Scott Feb. 1968 33 p refs
(Contract F19628-67-C-0262)
(TRW-06415-6003-R000; SR-3; AFCRL-68-0167; AD-672984)

This third scientific report of the investigation of radiation hardened insulated gate field effect devices presents the results of initial device testing with a Q-switched laser and the progress towards improved passivation films. A Q-switched, Nd doped glass laser has been used to show that VTM devices are an order of magnitude less sensitive to ionizing radiation than standard MIS devices without dielectric isolation. Deposited passivation films greatly reduce the leakage currents of n-channel VTM devices. Author (TAB)

N68-35324 National Lending Library for Science and Technology, Boston Spa (England).
BACKWARD WAVE OSCILLATOR AND RESONANCE BACKWARD WAVE OSCILLATOR WITH VARIABLE FREQUENCY RANGE
Franz Gross 5 Sep. 1968 9 p Transl. into ENGLISH from Siemens-Z. (Postfach), v. 4, 1965 p 367–369
(TRANS-2483) Available from Natl. Lending Library, Boston Spa, Engl.

These microwave generators with variable frequency range are designed to fulfill the requirements for ready amplitude and frequency modulation. Construction and functioning of the backward wave oscillator and the resonance backward wave oscillator are described. The backward wave oscillator has a variable frequency range from 26.5 to 43 GHz. Used with two other tubes briefly mentioned in this report (which work from 40 to 63 GHz and from 60 to 90 GHz, respectively), the frequency range of the three overlapping regions extends from 27 to 90 GHz. The resonance backward wave oscillator can be set at a random frequency within a very wide range, has a high output, and good frequency stabilization. Density modulation of the electron beam and efficiency are improved by resonance overlapping. The working frequency of this tube, which acts as a backward wave oscillator with a line resonator, depends mainly on the natural resonance. K.W.

N68-35372# Army Electronics Labs., Fort Monmouth, N. J.
THIN-FILM HYBRID MICROCIRCUIT DESIGN AND LAYOUT
Herbert C. Frankel Sep. 1967 53 p refs
(ECOM-2890; AD-673117)

This report describes the variety of techniques utilized by the Thin-Film Techniques Section of the Integrated Electronics Division, Electronic Components Laboratory, USAECOM, for the production of thin-film hybrid microcircuits. Each major step in producing such circuits is described, utilizing results from internal work and related information from USAECOM-supported contracts and literature sources. The emphasis in this report is on the role of the hybrid microcircuit designer and his interaction with the electronic circuit designer and thin-film fabrication specialists. The overall report is intended to provide the electronic circuit and equipment design engineer with an understanding of the capabilities and limitations of thin-film hybrid microcircuits and the design principles and practices involved. Such an understanding will help to guide his selection of the most appropriate microelectronic approach for a particular application. Author (TAB)

N68-35449# Illinois Univ., Urbana. Dept. of Computer Science.
OPTO-ELECTRONICS SWITCHING MATRIX
Tuh Kai Koo 28 May 1968 120 p refs
(REPT.-270; AD-672824)

A cross-bar type switching matrix system with photoconductive cells as basic switching elements and an optical signal as the switching driving source has been studied and developed. The switching unit at each crosspoint in the matrix contains three photoconductive cells in T-connection, in which the center branch is grounded and the two arm branches are connected to input and output channels respectively. Switching action is accomplished by scanning the matrix panel with a programmed light beam. The state of a switching unit depends upon whether the center branch or the arm branches are being excited by the light beam. The equivalent circuit of a photoconductive cell under the specific application has been developed. The complete equivalent circuit contains harmonic terms which are the consequence of optical beam scanning. These harmonic terms are responsible for the noise appearing at the output. The performance of the system is analyzed with the equivalent circuit. Its characteristics is described by defining transmission efficiency, cross-talk factor and injection noise factor. A prototype system with a capacity of four input channels and four output channels has been constructed to demonstrate the feasibility of the idea. Experimental results were very satisfactory. Author (TAB)

N68-35456# City Coll. Research Foundation, New York.
ELECTROSTATIC FOCUSING OF HOLLOW SPIRALING ELECTRON BEAMS Triannual Report No. 4, 1 Dec. 1967–31 Mar. 1968
Morris Ettenberg Jul. 1968 23 p
(Contract DAAB07-67-C-0159)
(ECOM-0159-4; AD-672790)

The first experimental tube was assembled and installed on a vacuum system for test. Extended bake out was necessary and the tube was not yet ready for test at the end of the reporting period. A program for the calculation of current at the collectors is being prepared. A procedure for the design of filaments is included as an Appendix. Author (TAB)

N68-35470# Fraunhofer-Gesellschaft zur Forderung der Angewandten Forschung e. V., Freiburg (West Germany).
DEVELOPMENT AND LABATORY-CONSTRUCTION OF A WIDE-BAND, SELFADJUSTING IMPEDANCE PROBE FOR MEASURING ELECTRON DENSITIES [ENTWICKLUNG UND LABORAUFBAU EINER SELBSTREGELNDEN, BREITBANDIGEN IMPEDANZSONDE ZUR MESSUNG VON ELEKTRONENDICHTEN BEI DER VERWENDUNG IN SATELLITEN]
E. Neske Bad Godesberg Bundesministerium Fuer Wiss. Forsch. Jul. 1968 48 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-68-48) CFSTI: HC$3.00/MF$0.65

A plasma condensator produces a phase shift between the input and output signal. At the resonance frequency there is no phase shift. This phase relation is used to build a laboratory unit which enables, with help of a voltage controlled oscillator, to adjust continuously the resonance frequency. This lagging adjustment provides advantages with regard to telemetry capacity. The phase run in a plasma condensator is calculated and interpreted. Author

N68-35482# Argonne National Lab., Ill.
PULSE DIVISION CIRCUIT FOR USE WITH POSITRON-SENSITIVE DETECTORS
W. R. Kuhlmann 1967 16 p refs Transl. into ENGLISH from German Report No. BMwF-FBK-67-61
(ANL-Trans-623) CFSTI: HC$3.00/MF$0.65

For experiments with detectors which give an analog information about the spot where the particle has entered the detector, an electronic pulse division circuit is evaluated. The circuit derives an output pulse $U_a \approx \ln (U_1/U_2)$ from two coincident input signals U_1 and U_2. These may vary in a range $1.0\ V \leq U_2 \leq 10$ V while (U_1/U_2) varies from 1.2 to 4.0. The output pulses may be analyzed directly by a pulse-height-analyzer. Author (NSA)

N68-35574# Texas Instruments, Inc., Dallas.
INVESTIGATION OF RADIATION EFFECTS IN SEMICONDUCTORS Interim Report
J. G. Aiken, M. G. Buehler, J. S. Crabbe, and W. T. Matzen Jun. 1968 15 p
(Contract F19628-68-C-0184)
(TI-03-68-39; AFCRL-68-0307; SR-1; AD-672990)

This program consists of two tasks and involves the investigation of fast neutron radiation effects in semiconductor devices. The object of Task I is (a) to determine bulk, epitaxial, and diffused-layer neutron-damage constants in silicon and (b) to correlate them with device parameters. The objectives of Task II are the correlations of neutron degradation of h sub FE with physical device constants and damage mechanisms. To accomplish these objectives, the following work is being performed. (1) A model is being developed and verified which predicts the variations of h sub FE with neutron fluence and current density in terms of the physical device constants. (2) A test pattern is being fabricated with various transistor base widths and concentration gradients. This test bar will be exposed to several levels of neutron fluence in order to develop and verify a model for h sub FE degradation. Photomasks and materials for the Task I and II studies have been received. Profiles have been chosen and diffusions are underway. The initial irradiation date has tentatively been set for 23 September. The computer program for the prediction of the h sub FE versus neutron fluence has been modified. Both the input and the recombination models have been revised. Author (TAB)

N68-35634*# Isotopes, Baltimore, Md. Nuclear Systems Div.
SOLID STATE BISTABLE POWER SWITCH STUDY
Herman Shulman and John Bartko Aug. 1968 25 p
(Contract NAS12-647)
(NASA-CR-86103) CFSTI: HC$3.00/MF$0.65 CSCL 09A

The feasibility of transforming an in-house developed device, the diristor, into a resettable fuse for high current applications was investigated. The device is a metal-impregnated organic insulator into which two electrodes are introduced. The following compositional parameters were varied: the metal particles, particle size, matrix material, metal/matrix ratio by volume, electrode size, electrode separation, electrode material, device design. It was found that the device is capable of carrying and tripping at high currents, i.e., ≈3 amp, if large metal particles (≈20 mesh) are used; the metal used must possess a coefficient of thermal expansion equal to or greater than that of copper, and the average trip current is a function of the size of the particles. For each matrix material there exists a range of mixture ratios which will provide optimum performance, while device parameters, such as average trip current and reset voltages, can be adjusted by choice of suitable mixture ratio. The electrode material has little or no bearing on the device operation or its parameters. The average trip current is inversely related to the electrode separation while the reset voltage is directly related to the separation. Author

N68-35696# Electrotechnical Lab., Tokyo (Japan).
SOME FUNDAMENTAL ASPECTS ON THE DESIGN OF POWER THYRISTORS. PART 2: SWITCHING MECHANISMS AND DYNAMIC PROPERTIES
Toshio Tsurushima and Mitsuo Kawashima Feb. 1968 115 p refs In JAPANESE; ENGLISH Summary
(Rept.-163) CFSTI: HC$3.00/MF$0.65

Dynamic properties of power thyristors and related phenomena are discussed. A brief review on history and present status of the thyristor, and the fundamental analysis of the thyristor operation are given. Problems related to turn-on transient phenomena of the thyristor are considered, and the variation of alphas and the turn-on criterion of the thyristor are included. Information is presented on turn-off mechanisms and interdynamic properties of the thyristor. Switching characteristics of p-n and p-i-n junctions are briefly reviewed. Carrier recombination mechanisms and life-time control with deep level impurities are described. Author

N68-35720*# ITT Industrial Labs., Fort Wayne, Ind. Industrial Labs. Div.
RESEARCH IN THE DEVELOPMENT OF AN IMPROVED MULTIPLIER PHOTOTUBE Final Report
E. H. Eberhardt, F. H. Barr, and P. R. Henkel 17 Jul. 1968 78 p refs
(Contract NASW-1516)
(NASA-CR-91079; ITTIL-68-023) CFSTI: $3.00 CSCL 09A

Investigations were made of triggered light sources afterpulsing, and materials required for multiplier phototubes. Alkali metals used in cathode formation and faceplate materials were considered, and light source calibration and efficiency of the phototube as a photon counter were studied. Multiplier types included those with fast rise time, with remotely processed cathodes, and without windows. Analysis made of standard multiplier phototube data in analog (dc) and digital (single-electron 10^{10} pulse count) modes of information processing, and tube specifications pertaining to characteristic values were appraised. Seven tubes were evaluated both as to their dc and photon counting characteristics to see if there was correlation between dark current and dark counting rate. When cooled to −30C, four tubes showed dark counts of about 20 to 30 counts/sec or less at 80 to 90% counting efficiency which indicated that dynode emission as well as cathode emission may be reduced to very low levels. Low amplitude pulse did not affect the dc measurements. M.W.R.

N68-35721# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
AM AMPLIFIER FOR THERMOCOUPLES [UN AMPLIFICATORE DI MARGINE PER TERMOCOPPIE]
F. Imperiali and E. Paolucci 1968 53 p refs In ITALIAN
(RT/EL(68)2) CFSTI: HC $3.00/MF $0.65

A differential amplifier for thermocouples, designated model 4003, was realized that permits temperature readings with considerable operator safety. Continuous control of temperature in the nuclear reactor is possible because of system that signals dangerous temperatures. General characteristics of the amplifier and its operational capabilities are detailed. Mathematical models for determining degree of amplification and thermocouple functioning are included, as are numerous circuit diagrams. Transl. by M.W.R.

N68-35722# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
RESEARCH ON BETTER RESOLUTION CONDITIONS IN SOME PHOTOTUBES OF COMMON USE IN GAMMA SPECTROGRAPHY [RICERCA DELLE CONDIZIONI DI MIGLIORE RISOLUZIONE IN ALCUNI FOTOTUBI DI USO COMUNE NELLA SPETTROMETRIA GAMMA]
A. Calza-Bini, G. F. Clemente, and F. Moncassoli 1968 23 p refs In ITALIAN
(RT/EL(68)1) CFSTI: HC $3.00/MF $0.65

Characteristics of some commercial photomultiplier tubes are presented, and studies were undertaken to improve the resolution of tubes used in gamma spectroscopy. With slight variations in the individual phototubes, the curves obtained indicate characteristic trends with two maximum. The first corresponds to tension in grid focalization between 15 and 40%, while the second maximum is less pronounced and sometimes extends beyond 50%. Placement of the phototubes is discussed in terms of the percentage resolution improvement. Transl. by M.W.R.

N68-35728# Atomics International, Canoga Park, Calif.
LOAD-SENSITIVE, LOW NOISE PULSE PREAMPLIFIER FOR USE WITH SEMICONDUCTOR DETECTORS OF NUCLEAR RADIATION
K. Langrod 24 May 1968 9 p refs
(AI-AEC-MEMO-12706) CFSTI: HC $3.00/MF $0.65

The design and construction of a novel preamplifier for semi-conductor detectors is described that has a stability of output increased by an order of magnitude, as compared with a common voltage preamplifier. Author (NSA)

N68-35733# Electrotechnical Lab., Tokyo (Japan).
MICROWAVE POWER STANDARD
Kentiro Sakurai Dec. 1967 124 p refs In JAPANESE; ENGLISH summary
(Rept.-680) CFSTI: HC $3.00/MF $0.65

The methods of precise measurement of microwave and millimeter-wave power are described in this paper, which have been developed as the first step of establishing the national standards in microwave and millimeter-wave regions. Twin type and Peltier type calorimeters are constructed as the primary power standards, in which RF power is measured precisely by use of direct current substitution method. The latter new method shows superior characteristics for precise measurements of millimeter-wave power. The experiments have been successful in the frequency region of 10 GHz and 35 GHz, the absolute accuracy of the measurements are evaluated with high accuracy. The precise comparison method of RF power standards using directional coupler and hybride T junction are also developed in order to transfer the standards. In addition several precise technologies which are needed to be developed for this work, such as automatic stabilization of RF power, precise self-balancing bridge for bolometric measurement, galvanometeramplifier etc., are described in this report. Author

N68-35788*# PanAura Corp., Pennsauken, N. J. Chemical Medical Electronics
EXPERIMENTATION PROGRAM FOR DEVELOPMENT OF PHOSPHOR FOR CATHODE RAY TUBE
31 Jan. 1967 54 p
(Contract NAS4-1084)
(NASA-CR-96002) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Improvements over existing monochrome and full color flying spot scanner systems were considered to have resulted from a study dealing with phosphor development for cathode ray tubes. Signal processing techniques for improving phosphor systems were also demonstrated. Phosphor development was concerned with extending the spectral emission of the $CaMgSiO_3$ (P-16) and related phosphors from blue toward red; and attempts to achieve considerable emission broadening were abondoned because of the resultant decay rates in the range of milliseconds. In favor of producing high quality films of whatever spectral shift could be achieved without appreciable increase in decay rate. Studies on ZnO (P-15 and P-24) phosphors also resisted substantial broadening of spectral emission without producing the desired results. Work on bismuth activated alkaline earth phosphates produced powdered phosphors that were efficient, more deeply saturated red, and decayed much faster than any previously available red phosphor. Good quality films were not, however, obtained. M.W.R.

N68-35829# Siemens A. G., Munich (West Germany).
DEVELOPMENT OF A GRID-CONTROLLED TRANSMITTING TUBE FOR SPACE APPLICATIONS [ENTWICKLUNG EINER GITTERGESTEUERTEN SENDEROEHRE FUER DEN RAUM-FLUG]
H. Blume Jun. 1968 118 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-68-40) CFSTI: HC $3.00/MF $0.65

Grid-controlled tubes for space application want very powerful cathodes delivering high current densities during extreme life. For this reason the metal capillary cathode (dispenser cathode) has been chosen; through extended investigations for formerly quite disturbing evaporation of Ba could be reduced to a non-significant value. The severe space conditions under which the 20 W and 100 W triodes are supposed to be used, asked for new principles of construction and imposed extended life tests. Therefore and for the measurement of their rf behaviour special amplifiers had to be built in which the tubes could be run under conduction cooling, thus approaching space conditions quite closely. Author

N68-35843# Oak Ridge National Lab., Tenn.
TRANSIENT ANALYSIS OF TRANSISTORIZED LOGARITHMIC AMPLIFIERS
Somchet Tangthieng (M.S. Thesis—Tenn. Univ., Knoxville) Jul. 1968 89 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2195) CFSTI: HC $3.00/MF $0.65

The transient analysis of transistorized logarithmic amplifiers employing a transistor as the logarithmic conversion and feedback element is presented. The variation of the log-transistor parameters are studied with respect to various levels of collector current, and the effects of these parameters on the oscillation stability of the amplifier are examined. This information is used to formulate the theoretical equations describing the transient behavior. NSA

N68-35948# Polytechnic Inst. of Brooklyn, Farmingdale, N. J. Dept. of Electrophysics
WIDE-ANGLE INTERNAL DEFLECTION STRUCTURES OF CATHODE RAY TUBES Triannual Report Number 5, 1 Nov. 1967–31 Mar. 1968
Rudolf G. E. Hutter Jul. 1968 19 p
(Contract DA-28-043-AMC-02449(E))
(PIBMRI-1355.5-68; ECOM-02449-5; AD-673715)

Questions of deflection sensitivity and wide-angle deflection are discussed. Incorporation of a wide-angle electrostatic deflection system into a cathode-ray tube requires the use of post-acceleration to counteract the resulting poorer deflection sensitivity. A small-size specially shaped deflection electrode system was designed and constructed and experimentally studied in a demountable vacuum system. Results of the investigation are reported. Author (TAB)

N68-35998* Army Electronics Labs., Fort Monmouth, N. J.
IDEALIZED VERSUS OPERATIONAL RELIABILITY OF RF POWER TRANSISTORS AS DETERMINED BY INFRARED SCANNING TECHNIQUES
Edward B. Hakim, Bernard Reich, and Gregory Malinowski Jul. 1968 18 p refs
(ECOM-2991; AD-673716)

Burn-out of power transistors is a continuing problem that we are all aware of. The problem is not only unique with audio devices but is also prevalent with devices for HF, VHF, and UHF operations. Limited technical information is available as to the conditions leading to the failure of RF power devices under operating conditions. By applying infrared scanning techniques, insight has been obtained on the mechanisms leading to failure. The infrared scanning results have proved, by means of operational amplifier results, that failures formerly noted can be eliminated, thus leading to trouble-free operations. The infrared radiometer used is commercially available. It has the potential of resolving a hot spot of 0.3 mils in diameter. RF hot-spot temperature measurements were made on several devices having different design parameters. Evaluation of devices was made by analysis of hot-spot thermal resistance plots. Included are data of experiments made on devices under pulsed dc operation. Results from the operational amplifiers are then compared with the pulsed data. RF operational data is presented at both 30 MHz and 76 MHz. Data of various load terminations are presented and analyzed. From these results it has been possible to realistically rate RF power transistors to operate under nearly any load termination. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-34813 Polytechnic Inst. of Brooklyn, N. Y.
EQUILIBRIUM ANALYSIS AND ITS APPLICATION TO ATTITUDE CONTROL SYSTEMS
William Norton Rediach (Ph.D. Thesis) 1967 136 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 67-13413

A method is developed that utilizes computer simulation in conjunction with theoretical techniques to obtain a high degree of confidence in a stability analysis. The roles of equilibrium points in higher-order attitude control systems are explored. For general physical systems, $x = f(x)$, all limit cycles are associated with equilibrium points that lie "inside" the limit cycles. Thus, if no equilibrium point exists in a region, then no limit cycle is contained in that region. Special properties of limit cycles and equilibrium points are discussed and illustrated. Equilibrium points are found analytically for spacecraft attitude control systems. A method is devised to determine stability near these equilibrium points. Examples of actual systems are presented to demonstrate the powerful nature of this approach. Hence, instead of utilizing a uniform or random n-dimensional grid of computer initial conditions, a grid is concentrated around a few calculated points. When control systems are viewed in this light, a high degree of confidence is gained from several hundred computer runs; previously such confidence was obtained only after several hundred thousand runs. Dissert. Abstr.

N68-34819 Polytechnic Inst. of Brooklyn, N. Y.
INCLUSION PROBABILITY OPTIMAL CONTROL
Leo Jozef van Mellaert (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-13427

A multi-dimensional stochastic dynamical system is considered. The system can be nonlinear and time-varying. It is assumed that the state of this system can be measured noise-free at all times. An optimal control policy is formulated leading to the maximization of the probability of constraining the trajectory of the system to a certain subregion of the state-space over a finite period of time. On the basis of dynamic programming an optimization equation is derived. This equation is a quasilinear second order parabolic partial differential equation. The equation is solved on a digital computer. The numerical technique appears to be highly efficient in speed and memory requirements. Examples are included for first and second order dynamical systems. Dissert. Abstr.

N68-34884 Northwestern Univ., Evanston, Ill.
NEW TECHNIQUES IN SUBOPTIMAL LINEAR FILTERING
Donald Valentine Starich (Ph.D. Thesis) 1967 73 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 67-15346

The technique advanced in this thesis is based upon theoretical considerations of the effects of both diagonal variances of states and off-diagonal covariances of states on the estimation process. It proposes that some states can be represented by only propagating diagonal variances and still be suboptimally estimated. Other possible suboptimal configurations are also postulated. The suboptimal technique is applied to a 35 state Doppler inertial error model with good results. While the computational saving is not as great as that which may be afforded by subsystem partitioning, the suboptimal configuration can be achieved with little trial and error involved. A design method is proposed which leads to isolation of the states which can be deleted and the states which can be deleted and the states which can be represented by only diagonal variances. Dissert. Abstr.

N68-34887 Florida Univ., Gainesville.
DESIGN OF TIME-OPTIMAL DIGITALLY SIMULATED SYSTEMS
Joseph Stanley Rosko (Ph.D. Thesis) 1966 176 p
Available from Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 67-13159

As a prelude to optimal simulation of transfer functions, numerous discrete/approximate integrating operators with diverse origins are presented on a common ground through the mechanism of z-transform theory. Mathematical models are developed which permit the prediction of integration error for a prescribed excitation. These models establish mean-square error by considering both discrete simulation and discrete simulation with interpolated intervals. A technique for digitally simulating transfer functions is developed employing six different approximate substitutional integrators. Algorithms are tabulated for determining the digitally approximated response of systems whose input and output are describable in terms of linear differential equations of order four or less. In particular, the flexibility of this technique over that suggested by sampled data theories is demonstrated. From the integration-error models evolve mathematical models and formulations to predict system simulation error. This is coalesced with quasilinearization and Lagrangian interpolation and then applied to performance indices to attain time-optimal simulation with either deterministic or stochastic excitation. Dissert. Abstr.

N68-34932* Arizona Univ., Tucson. Analog/Hybrid Computer Lab.
STUDY OF A NONLINEAR LEAD COMPENSATOR

W. P. Jenney 10 Jan. 1967 11 p refs
(Grant NsG-648)
(NASA-CR-96880; ACL-MEMO-151) CSCL 09C

Design and functioning of a split path nonlinear (SPAN) compensator filter and its application to waveform analysis are described. Performance of the SPAN compensator is shown in a third-order control system, and a linear servomechanism is used to compare the SPAN compensation with that of a conventional lead–lag and an optimal linear controller. K.W.

N68-34973 Purdue Univ., Lafayette, Ind.
THE ITERATIVE DYNAMIC PROGRAMMING SOLUTION OF A CLASS OF OPTIMAL REGULATOR PROBLEMS
Duane M. Davis (Ph.D. Thesis) 1967 130 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-16634

The solution of regulator problems is particularly difficult because the period of time of application of control is an unknown which is a function of the initial state. For the most part, realistic problems have defied analytic solution. Therefore, we must depend upon numerical methods. The unknown time (duration) of the regulator problem makes it difficult to handle by the existing numerical methods. An iterative method is developed and presented for applying dynamic programming to regulator problems. Because of the discrete nature of the method the class of regulator problems of interest is limited to those for which the terminal manifold consists of a finite portion of the state space (as distinguished from a single point). This is a reasonable restriction since it is extremely difficult to develop a controller for a physical system that will drive the system to a point, even if the optimal control law is known. Dissert. Abstr.

N68-35136# California Univ., Livermore. Lawrence Radiation Lab.
ON THE DESIGN OF GROUND CIRCUITS
R. W. Buntenbach *In its* Noise Reduction Conf. [1968] p 215–224 (See N68-35118 22-23)

Complex electronic systems are frequently subject to undesirable and sometimes intolerable disturbances in the so-called ground side of single-sided circuits. These have been thought to be of a somewhat nebulous nature and have therefore been treated as a form of noise. This paper suggests that the occurrence of such problems has been largely due to the lack of law and order in the design phase. An orderly approach to the design of common side circuits can be made by proceeding in accordance with the following steps: (1) restriction of the term "ground circuit" to cases where an actual connection to the earth is intended; (2) use of the term "common circuit" or "return circuit" to denote the low side of single-side circuits; (3) provision of a separate return circuit for each and every voltage source in the system; and (4) specification of the magnitude and direction of each and every current appearing in each return circuit. This is done at the schematic stage and continues into the wiring diagram stage. Schematics made in accordance with (3) and (4) reveal that the interaction disturbances resulting from the flow of many current components in common circuits are not nebulous but rather can be recognized as (a) feedback effects, (b) cross-talk effects and (c) inductive-loop effects. Magnitude and direction information enables the application of engineering principles which reduce the feedback factors and cross-talk coefficients to negligible values. Segregation of return circuits aids in the prevention of inductive loops. With the establishment of orderly design procedures comes the realization that the design of return circuits, the faults which can occur, and the preventive measures necessary are much the same as for high-side circuits, with the exception that common circuits, by definition, must carry a multiplicity of current components. The problems posed by this mixture of currents are readily soluble by customary engineering procedure when approached in an orderly manner. Author

N68-35239# Illinois Univ., Urbana. Coordinated Science Lab.
AN APPLICATION OF TERNARY LOGIC TO LOGIC SEQUENCING
Anthony S. Wojcik Jul. 1968 75 p refs
(Contract DAAB07-67-C-0199; Grant NSF GP-690)
(R-388; AD-672757)

The purpose of this report is to investigate the feasibility of using ternary logic and ternary logic elements to design an arithmetic control that is comparable in function to the Arithmetic Control of the ILLIAC II and to discuss some of the results of this construction. First, the fundamental theory of ternary algebra is presented, function representation and minimization discussed, and a ternary design technique developed. A basic description of the ILLIACs Arithmetic Control is given for purposes of understanding design criteria and of establishing a motivation for using ternary logic. Finally the logical design of Basic Logic Blocks is discussed, and several problems and suggestions for future work are considered. Author (TAB)

N68-35273# Illinois Univ., Urbana. Coordinated Science Lab.
USE OF THE COMPANION TRANSFORMATION IN PARAMETER OPTIMIZATION AND ADAPTIVE CONTROL
Dennis Frank Wickie Jul. 1968 86 p refs
(Contract DAAB07-67-C-0199; Grant AF-AFOSR-931-67)
(R-386; AD-672758)

The transformation to companion canonic form for single-input, linear, time-invariant systems is shown to have important applications in the sensitivity analysis of control systems as well as in parameter optimization and model reference adaptive control problems. Two previously unknown properties of a system in companion form are demonstrated. These are the Total Symmetry Property of the sensitivity matrix of a system in companion form and the Complete Simultaneity Property. The latter states that all the sensitivity functions of the states of a companion form system can be generated by linear combinations of the signals on one sensitivity model of the system and the system states. Author (TAB)

N68-35290# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD FOR SOLVING OPTIMAL PROBLEMS [METOD RESHENIYA OPTKMAL'NYKH ZADACH]
A. A. Bolonkin 8 Sep. 1967 41 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Slozhnyye Sistemy Upr. (Kiev), 1965 p 34–67
(FTD-MT-24-200-67; AD-673185)

A system described by a finite number of ordinary differential equations is taken for which the optimum problem is defined. Values are found which minimize a certain performance functional. The optimum problem formulated in this manner differs from the classical variational problem: not only the control function, but also the structural parameters are to be optimized and the study of the optimum problem is carried out in the class of functions whose first derivatives with respect to an independent variable can assume infinite values. A theorem is proved which establishes sufficient conditions under which the performance functional has an absolute minimum. Author (TAB)

N68-35404# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
LEARNING CONTROL SYSTEMS AND PATTERN RECOGNITION
James W. Moore, E. S. McVey, R. L. Ramey, E. J. White, and R. M. Bowman 15 Apr. 1968 125 p refs
(Contract DAAB07-68-C-0066)
(ECOM-0066-1; AD-672089)

The report covers progress in the first six months on a Project THEMIS Contract for research in Learning Control Systems

and Pattern Recognition. Topics covered include the general approach to learning control systems, finite state sequential machines, thin film deposition research, adjustment of light gain of phototransistors, and some considerations on the optimal design for a single font character recognition machine. This latter is in the form of a final report and is described below in more detail. A means of constructing an inexpensive single font alphabetic character recognition machine is presented. Major parameters are considered and constraints chosen to minimize costs. A method for choosing a minimum set of invariant characteristics using probability theory and a priori noise immunity is presented. Results include a relation between noise immunity and the array size into which characters are quantized, indicating a maximum noise immunity of 30.9%. A hypothesis relating character set size and character similarities is stated. Author (TAB)

N68-35723# Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics.
THE USE OF CONSOLIDATED EXPANSIONS IN SOLVING FOR THE STATISTICAL PROPERTIES OF A NONLINEAR OSCILLATOR
Jeffrey B. Morton (Ph.D. Thesis) Oct. 1967 187 p refs
(Contract Nonr-4010(05))
(AD-673235)

We consider a nonlinear harmonic oscillator driven by random, Gaussian noise. The oscillator is damped and has linear and cubic terms in the restoring force. The Fourier transform of the solution of this equation, usually referred to as the Duffing equation, is expanded in a series in the coefficient of the cubic term. This series is then squared to give a series for the spectrum of the response. Each term in this series is expressed in terms of the solution of the linearized harmonic oscillator (i.e. without the cubic term). Since the forcing function is Gaussian, the solution of the linearized harmonic oscillator is Gaussian. Thus each term in the series for the response spectrum can be expressed as a function of the spectrum of the linear oscillator using the properties of a Gaussian random function. The numerical results indicate that the consolidated equations provide a substantial improvement over other methods used to solve this type of problem. Author (TAB)

N68-35785# Joint Publications Research Service, Washington, D. C.
CONTROL IN LARGE SYSTEMS
A. Ya. Lerner 30 Sep. 1968 26 p Transl. into ENGLISH from the Book "Tekhnicheskaya Kibernetika v SSSR" Moscow, Nauka Press, 1968 p 200–221
(JPRS-46561) CFSTI: HC$3.00/MF$0.65

Principles of mathematical modeling of large systems are discussed, along with the inherent difficulties caused by the high dimensionality, structural complexity, multiplicity of nonlinear relations between variables, probabilistic nature of parameter changes, and solely stochastic relationships among the variables of large systems. Attention is given to the analysis and synthesis of system structures, control of operations, and the distribution of resources such as materials, personnel, and money. Control of production complexes and various aspects of control theory are considered. M.W.R.

N68-35957# Syracuse Univ., N. Y. Dept. of Electrical Engineering.
CONTRIBUTIONS TO THE STABILITY ANALYSIS OF SYSTEMS USING FUNCTIONAL ANALYSIS METHODS
John S. Krikorian, Jr. Jul. 1968 122 p refs
(Contract F30602-68-C-0022)
(RADC-TR-68-231; AD-673909)

New stability criteria for nonlinear, time-varying control systems both in continuous and discrete form, have been obtained using functional analysis methods. Several of the new results involve simple geometrical constructions in the complex frequency plane which provide the required stability information in a manner similar to the Popov criterion. The contraction mapping fixed point theorem is used to obtain information on the finite time stability of a class of continuous and discrete systems. The discussion on the finite time stability of systems, while not exhaustive in its treatment of different classes of systems, does give a representative indication of what can be accomplished using this fixed point theorem. A class of systems is investigated in which each system consists of a parallel combination of a time-varying gain and a static nonlinear operator, followed by an operator that satisfies an inner product inequality. A second class of systems is investigated in which each system is characterized by a series combination of a time-varying gain and a static nonlinear operator, followed by an operator that satisfies an inner product inequality. A geometrical interpretation, similar to the Popov criterion, is used to determine the stability of a system from these two classes of systems when the operator satisfying the inner product inequality is a linear time-invariant convolution operator. Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-34930# Joint Publications Research Service, Washington, D. C.
THE SADKO-2 UNDERWATER LABORATORY
A. V. Mayer, V. Ye. Dzhus, and A. V. Ignatiyev 13 Sep. 1968 8 p Transl. into ENGLISH from Sudostroyeniye (Leningrad), May 1968 p 11–14
(JPRS-46427) CFSTI: HC$3.00/MF$0.65

A general description is offered of the SADKO-2 underwater laboratory of dual sphere construction. The upper sphere is outfitted for continuous habitation by two aquanauts, while the lower sphere is a service facility. The laboratory is connected to shore by a diving hose for emergency breathing and two multiconductor electrical cables; one cable takes care of electrical power and communications, the other transmits television images and indications of the monitoring and metering instruments. Results of six days submersion at a depth of 25 meters indicated that the first three days were required for the human body to acclimate to the increased pressure. During trips outside the laboratory, the aquanauts explored areas to a depth of 45 meters. Decompression time for the men following the underwater experience was 70 hours. M.W.R.

N68-35301# Aro, Inc., Arnold Air Force Station, Tenn.
THEORETICAL PERFORMANCE OF THE EXPANSION TUNNEL OPERATING IN THE HIGH DENSITY TEST REGIME Final Report, Sep. 1967–Jan. 1968
Glenn D. Norfleet Arnold Eng. Develop. Center Jul. 1968 102 p refs
(Contract F40600-69-C-0001)
(AEDC-TR-68-104; AD-672762)

Theoretical real gas performance calculations were made for the expansion tunnel operating in a high density regime at modest velocity. Both Mach number-Reynolds number simulation and flow duplication were considered. Typical results and detailed working graphs are presented. To illustrate the potential of the expansion tunnel, the performance was calculated for the case of a 1000K, 5000-atm helium driver. This example illustrates that the expansion tunnel does show promise for testing in the high density regime at modest velocity. Author (TAB)

N68-35312 National Lending Library for Science and Technology, Boston Spa (England).
RESULTS OF WIND TUNNEL EXPERIMENTS AT THE MAIN GEOPHYSICAL OBSERVATORY
P. V. D'jachenko and A. I. Kamaneva [1968] 14 p refs Transl. into ENGLISH from Glav. Geof. Obs. (Leningrad), no. 101, 1959 p 51–59
(M-7409) Available from Natl. Lending Library, Boston Spa, Engl.

The GGO wind tunnel at the main geophysical observatory in the USSR is described, and results are included for some experiments conducted at both low and medium speeds. The medium speed studies indicated the speed distribution in the cross section of the wind tunnel through the center of the working field can be considered constant in time; however, it was concluded that the wind tunnel was not suitable for testing vane anemometers at speeds below 0.4 m/s because at such speeds the temperature difference affects the uniformity of the speed distribution. This wind tunnel, which was constructed in 1932, permits the testing of instruments in the 0.5 to 20 m/s range. Fluctuations of air stream speed are considered, along with the direction of the flow at slow speeds using a specially-constructed cylindrical nozzle. M.W.R.

N68-35396# Library of Congress, Washington, D. C. Aerospace Technology Div.
SATELLITE TRACKING FACILITIES
Daniel W. Michaels Jul. 1968 79 p refs
(ATD-68-119-101-4; AD-672794)

The report discusses the organization, station network, optical tracking capabilities, and current observation programs of Soviet-bloc, primarily USSR, satellite observation stations. Emphasis is on the optical and radio facilities employed in near-space rather than deep-space tracking. The difficulties encountered by the Soviet Union in developing advanced tracking instrumentation and the methods elected to overcome them are outlined. Author (TAB)

N68-35466*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A DIGITAL COMPUTER PROGRAM FOR CALCULATING THE PERFORMANCE OF SINGLE OR MULTIPLE DIAPHRAGM SHOCK TUBES FOR ARBITRARY EQUILIBRIUM REAL GAS MIXTURES
William L. Grose, John E. Nealy, and Jane T. Kemper Washington Oct. 1968 59 p refs
(NASA-TN-D-4802) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A computer program written in FORTRAN IV language is presented which determines the performance of a shock tube. For specified initial gas composition and charging conditions, the program output includes velocity, pressure, density, enthalpy, temperature, sound speed, and species mole fractions at any point in the shock tube cycle. Several representative calculations illustrate the utility of the program. The program is applicable to both simple and buffered shock tubes as well as to the expansion tube. Author

N68-35586# Deutsche Forshungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strahlantriebe.
DEVELOPMENT, TESTING AND MEASURING OF A CIRCUIT HOT AIR WIND TUNNEL [ENTWICKLUNG, ERPROBUNG, UND VERMESSUNG EINES HEISSLUFT-WINDKANALS]
Wolf Splettstoesser 30 Jan. 1968 39 p refs In GERMAN; ENGLISH summary
(DLR-MITT.-68-14) CFSTI: HC $3.00/MF $0.65

The development of an open circuit hot air wind tunnel for studies of the evaporation of hydrocarbon layers is reported. The determination of the theoretical operating curve of the channel is described. Design details for the axial flow blower and the electrically powered heating device as well as the results of the channel testing are presented. The particular requirements to the channel with regard to velocity, temperature, and turbulence are verified in the free jet by measurements of the temperature profiles, velocity profiles, and the degree of turbulence. Author

N68-35647# Deutsche Versuchanstalt fur Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Raumsimulation.
THE TWO AXIS MOTION GEAR FOR THE BIG SPACE SIMULATION CHAMBER OF THE SPACE SIMULATION INSTITUTE WITHIN THE DVL AT PORZ-WAHN [DER ZWEIACHSEN-BEWEGUNGSSIMULATOR FUER DIE GROSSE RAUMKAMMER DES INSTITUTS FUER RAUMSIMULATION DER DVL IN PORZ-WAHN]
W. Hallman Jan. 1968 60 p refs In GERMAN; ENGLISH summary
(DVL-746; DLR-MITT-68-16) CFSTI: HC $3.00/MF $0.65

The motion gear is designed to simulate motion and position of satellites relative to the sun. This paper gives details on the design and relates some experiences gained during operation. Trajectory behavior of satellites is discussed as far as such information is required for the operation of the simulator. Bearings, sealings, lubrication, and the drive mechanism for operating the device under high-vacuum conditions are described as well as attitude indication, instrumentation, and control. K.W.

N68-35914# Stanford Univ., Calif. Linear Accelerator Center.
CONSIDERATION OF THE USE OF FEEDBACK IN A TRAVELING WAVE SUPERCONDUCTING ACCELERATOR
R. B. Neal Jun. 1968 24 p refs Presented at the Conf. on Superconducting Devices and Accelerators, Upton, N. Y., 10 Jun.–19 Jul. 1968
(SLAC-PUB-437; CONF-680621-1) CFSTI: HC $3.00/MF $0.65

The use of feedback with traveling-wave linear accelerators is discussed. Topics include optimum feedback in the TW accelerator with beam loading; fixed bridge ratio g in the TW accelerator with beam loading; power dissipation in the TW accelerator, resistive load, and feedback loop; filling time of TW accelerator with feedback; standing wave superconducting structure with beam loading; and filling time of standing wave structure. A comparison was made of the traveling wave and standing wave designs. NSA

N68-35915# California Univ., Berkeley. Lawrence Radiation Lab.
MEASUREMENT OF OMNITRON CRYOPUMPING AND OUTGASSING BY 10^{-16} TORR PULSE COUNTING MASS FILTER
Norman Milleron, Richard Wolgast, and Joachim M. Nitschke Apr. 1968 13 p refs Presented at the 4th Gen. Meeting on Intern. Organ. for Vacuum Sci. and Technol., Manchester, England, 17–19 Apr. 1968
(Contract W-7405-ENG-48)
(UCRL-17845; CONF-680401-4) CFSTI: HC $3.00/MF $0.65

The Omnitron is a new type of synchrotron accelerator with a storage ring that will deliver beams of light and/or heavy ions to different experiments almost simultaneously. Storage of heavy ions in a high charge state for 20 msec. requires that the vacuum environment be assessed more carefully than can be done by the sum of the partial pressures convention. A crude figure of merit, $10^{14} \leq N \cdot \Sigma n_i Z_i^2$ is used where: $N = 3 \times 10^7$ turns around the accelerator, n_i = the concentration of atoms of the i^{th} atomic number Z_i. To ensure that this figure of merit is met, outgassing from materials and pumps and pumping speeds are assessed by counting ions from a quadrupole mass filter that can indicate average concentrations of light gas to 10^{-16} torr and $<10^{-15}$ torr of ions with m/e up to 500. Using this together with an accumulation method, contamination coming from oil D.P. and M.P. systems having special LN traps and valves is shown to be negligible. Author (NSA)

N68-35961# Oak Ridge National Lab., Tenn.
THE STACKED-CLONE CONTRACTOR: A HIGH-PERFORMANCE SOLVENT EXTRACTION MACHINE HAVING POTENTIAL FOR USE IN THE PROCESSING OF HIGHLY RADIOACTIVE NUCLEAR FUELS
W. S. Groenier and M. E. Whatley Jul. 1968 48 p refs
(Contract W-7405-eng-26)
(ORNL-4267) CFSTI: HC $3.00/MF $0.65

The stacked-clone solvent extraction contactor has developed into a machine of high performance. The basic principles of operation were demonstrated to be valid. Both experimental and prototype models were built and operated; three sizes of experimental models have been tested; and a scale-up concept evolved. Future scaled-up versions will probably have contact times of less than 1 sec per stage at a reasonable flow capacity and at stage mass-transfer efficiencies greater than 70%. The rapid response of the contactor would allow a short turnaround time between campaigns. Its most promising application involves the processing of very highly radioactive nuclear fuels. Author (NSA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-34842# Aeronautical Research Council (Gt. Brit.)
THE CALCULATION OF TURBULENT BOUNDARY LAYERS WITH INJECTION
J. McQuaid 1968 51 p refs Supersedes ARC-28868
(ARC-R&M-3542; ARC-28668; PD-4171; AD-835949) CFSTI HC $3.00/MF $0.65

A new two-parameter family of mean velocity profiles for turbulent boundary layers with injection is described. The profile model adopted uses the inner law of Stevenson, shown elsewhere Mc Quaid to be in good agreement with the constant-pressure measurements of the present author, and the present author, and the intermittency hypothesis of Sarnecki shown here to be in good agreement with these same measurements. The family is thus analogous to that presented by Thompson for solid-surface boundary layers. Comparisons are made between the family and velocity profiles obtained in layers with pressure gradients of different sign and severity and good agreement is obtained provided the pressure gradient is within limits determined by the reliability of the constant-pressure inner law used in the model. The skin-friction law obtained from the family in terms of the parameters H, R sub theta and v sub o/ U sub 1 is presented in chart form. The auxiliary equation of Head is shown to give satisfactory predictions of shape-factor development for layers both with and without pressure gradient. A discussion is included on a boundary layer with a discontinuity in the injection velocity distribution, the injection velocity being suddenly reduced to very nearly zero the region of adjustment to solid-surface conditions downstream of this change is described. Author (TAB)

N68-34853# National Aerospace Lab., Amsterdam (Netherlands).
THE POTENTIAL FLOW ABOUT A YAWED ELLIPSOID AT ZERO INCIDENCE
R. Timman [1967] 24 p refs
(F-74) CFSTI: HC $3.00/MF $0.65

A general method for the calculation of three dimensional boundary layer flow has been developed. In these calculations the potential flow about the body considered is assumed to be known. A case, which is of considerable interest from a practical point of view is that of the boundary layer of a swept back wing. In order to simulate conditions on a swept back wing a yawed ellipsoid at zero incidence is considered. The free stream direction of the undisturbed flow is in the plane of the two largest axes of the ellipsoid. The formulae for the flow about an ellipsoid are well known and can be applied directly. For the determination of the surface stream function, it is necessary to determine the stream lines on the surface. As the differential equations cannot be solved exactly, the stream lines must be calculated by numerical methods. This numerical calculation has been performed under the direction of Mr. Burgerhout and Mr. Ruiter of the computation office of the National Aeronautical Research Institute. As the results are assumed to be of some interest independently of the application to the boundary layer flow, they are given here. Author

N68-34877 Case Inst. of Tech., Cleveland, Ohio.
INTERACTION REGION IN THE BOUNDARY LAYER OF A SHOCK TUBE
Stephen Dennis Ban (Ph.D. Thesis) 1967 144 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-16056

The velocity and temperature boundary layers developed on a plane wall by the ideal shock-tube flow are considered for the case of weak shock and expansion waves. Under the weak wave assumption the expansion wave is replaced by a line discontinuity. The time-dependent Prandtl boundary-layer equations in the Crocco variables are adopted as the governing equations. The boundary layer is divided into three regions: where the solution is that behind an advancing plane shock, where the expansion wave boundary-layer solution holds, and where the two solutions just mentioned must merge. Here the governing equations are singular parabolic: they admit boundary conditions normally associated with elliptic equations. The equations are linearized for weak waves. Numerical solution is carried out in the three regions of interest. In the interaction region the governing singular parabolic equation is solved successfully by an iterative finite difference method normally applied to elliptic equations, but in the present case is applicable to the parabolic equation of interest. Uniqueness and existence of a solution to the singular parabolic equation is discussed. Dissert. Abstr.

N68-34891 Arizona Univ., Tucson.
ON THE EXACT FORM OF GRAVITY WAVES ON THE SURFACE OF AN INVISCID LIQUID
James William Thomas (Ph.D. Thesis) 1967 73 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 67-11964

Consider a two-dimensional inviscid liquid of either finite or infinite depth at rest in a constant gravitational field. Let the surface of the liquid be disturbed by a wave of constant form, periodic and moving with a constant velocity c. The problem under consideration is to find the exact form of this periodic wave. The method of treatment of the problem is to map the region occupied by one wave length of the liquid onto an annulus or a circle according to whether the liquid has finite or infinite depth. The complex potential of the fluid motion in the new region and the mapping function will give complete knowledge of the original flow. The pressure condition on the free surface, along with several known properties of the mapping function, reduces the problem, in the cases both of finite and of infinite depth, to solving a nonlinear integral equation. An iterative technique developed for the numerical solution of the integral equation for the case of infinite depth is introduced. It is shown that this technique also applies to the integral equation corresponding to finite depth. Several solutions of the two equations are obtained and their corresponding wave profiles exhibited. Dissert. Abstr.

N68-34897 Northwestern Univ., Evanston, Ill.
NORMAL SHOCK REFLECTION FROM NEARLY FLAT WALLS
Melbourne George Briscoe (Ph.D. Thesis) 1967 156 p

Available from Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 67-15194

The thesis reports an experimental and theoretical study of normal shock reflection from nearly flat walls. The experiment is performed in air at room temperature and pressure in a conventional diaphragm shock tube. The theory is a modification of R. M. Zaidel's study of shock production by a corrugated piston and is linearized on the assumption of small wall slopes. The solution yields the perturbation amplitude as a function of the number of wavelengths from the wavy wall; the parameters are incident Mach number and the ratio of specific heats. A perfect gas is assumed. The experiments provide schlieren photographs of the reflected shock front; a two-flash, short-duration stroboscope is the light source. Data is measured with a micrometer-controlled optical comparator; three wavey walls of different slopes and a Gaussian wall are used as data sources. The theory also gives the distribution of perturbation density between the wavy wall and the reflected shock front. Dissert. Abstr.

N68-34898 Northwestern Univ., Evanston, Ill.
THE IMPINGEMENT ON A LIQUID SURFACE OF THE TWO-DIMENSIONAL INCOMPRESSIBLE EFFLUX FROM A NOZZLE
Robert Glenn Burman (Ph.D. Thesis) 1967 93 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-15197

The problem of a two dimensional gas jet issuing from a nozzle and symmetrically impinging on a dense liquid surface is considered. Potential flow theory used in conjunction with conformal mapping permits the physical problem to be formulated in terms of a singular integral equation involving two nondimensional parameters. An approximate analytic solution to the singular integral equation is obtained. The approximate solution is valid for shallow cavities. For variable jet height, an explicit expression for the vertical coordinate of a point on the liquid-gas interface is derived which predicts the existence of ripples on the liquid surface. The horizontal coordinate of a point on the liquid-gas interface and the coordinates of a point on the free streamline are numerically evaluated. Dissert. Abstr.

N68-34902 Tennessee Univ., Knoxville.
LOCAL RATES OF MASS TRANSFER FROM SPHERES IN SIMPLE CUBIC PACKING AND A NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR VISCOUS FLOW PAST A SINGLE SPHERE
John Mark Rhodes (Ph.D. Thesis) 1967 250 p
Available from Univ. Microfilms: HC $11.25/Microfilm $3.25 Order No. 67-15786

This dissertation reports the results of an experimental investigation of the local rates of mass transfer from spheres in simple cubic packing to a flowing fluid. While extensive literature is available on the overall mass transfer rates in packed beds, there is an absence of data on local mass transfer rates. An experimental method involving the measurement of the local radius change of a slightly soluble 2-naphthol sphere was used to determine the conplete local mass transfer situation at particle Reynolds numbers of 22,800, 46,400, and 69,000. Special emphasis was placed on the regions adjacent to points of contact between spheres. These regions were studied at Reynolds numbers of 25,200 and 48,000. Dissert. Abstr.

N68-34921# Princeton Univ., N. J.
REVIEW OF SECOND-ORDER WAVE STRUCTURE
David A. Caughey and Wallace D. Hayes *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 129-132 refs (See N68-34907 22-02)

The second order correction to the wave system associated with a body in supersonic flight is determined by an asymptotic series representation of the solution, valid to all distances from the body. The method matches asymptotic expansions for large distances to local solutions near the body which satisfies the actual boundary condition. Cumulative nonlinear effects are considered and shocks are inserted according to the appropriate conversation laws. G.G.

N68-34925# Princeton Univ., N. J.
GEOMETRIC ACOUSTICS AND WAVE THEORY
Wallace D. Hayes *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 159-164 refs (See N68-34907 22-02)

Geometric theory of general linear wave propagtion starts with a study of linear solutions in an uniform medium which are proportional to functions of a phase variable $\phi = k \cdot r - wt$, with r a distance variable in a suitable euclidean space and k a vector wave number. The study yields a dispersion relation term. If w is real when k is real, the waves are termed nondissipative. The solutions obtained are for plane waves, the waves being planar in their space. An asymptotic theory for a slowly varying nonuniform medium gives differential equations with ray characteristics where the functions of space may be arbitrary and not sinusoidal. G.G.

N68-34926# Princeton Univ., N. J.
SIMILARITY RULES FOR NONLINEAR ACOUSTIC PROPAGATION THROUGH A CAUSTIC
Wallace D. Hayes *In* NASA 2nd Conf. on Sonic Boom Res. 1968 p 165-171 refs (See N68-34907 22-02)

A caustic in geometric acoustics has a characteristic scale which may be visualized as proportional to the inverse of the relative curvature of a ray and its scale R is defined in terms of wave front shape. Acoustic signals of length L which may be the total or spatial period of a sonic boom signal, can be analyzed by boundary layer approach if the ratio L/R is sufficiently small at separate inner and outer analyses. The inner analysis, in a thin region including the caustic, is a local analysis with stretched coordinates where the thin region is interpreted as the boundary layer and where the weak nonlinear effects are taken into account. A moving coordinate system is used to obtain the ray trajectories in four dimensional spacetime, with the caustic as hypersurface in space. G.G.

N68-35002 Northwestern Univ., Evanston, Ill.
SLOW FLOW OF A NON-NEWTONIAN FLUID PAST A DROPLET
Martin Gerald Wagner (Ph.D. Thesis) 1967 96 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-15359

The problem of slow flow past a droplet where both fluids may be represented by third order Rivlin-Ericksen models and the outer fluid is of infinite extent is considered. Both non-Newtonian and inertial effects are considered. A double perturbation technique and the method of matched asymptotic expansions are employed to handle the non-Newtonian and inertial terms in the equation of motion. Series solutions for the stream functions inside and outside the droplet, the drag force, and the deformation of the droplet are obtained. It is found that only the predicted deformation may be compared with the available literature data. This comparison yields only qualitative confirmation of the theory. Dissert. Abstr.

N68-35004 Northwestern Univ., Evanston, Ill.
A VARIATIONAL APPROACH TO TWO-PHASE FLOW PROBLEMS
Robert Ehrlich (Ph.D. Thesis) 1967 72 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 67-15225

The first section of this dissertation consists of the development of an original variational method that may be used to obtain solutions to two-phase creeping flow problems involving a free

interface. In the second section, flow around a drop falling slowly in an infinite vertical tube is considered. The variational method permits successive approximations to be made to the drag coefficient and terminal velocity of the drop. These approximations are based on successively better interface shape and velocity distribution trial functions. The third section describes the experimental investigation of a drop falling in a vertical tube. The successive approximations appear to be converging towards the experimental results. This convergence, however, does not appear to be rapid. Dissert. Abstr.

N68-35014 Purdue Univ., Lafayette, Ind.
WAVE AMPLITUDE STUDY FOR TWO-PHASE FLOW IN A HORIZONTAL CHANNEL
Robert Allen Helfinstine (Ph.D. Thesis) 1967 154 p
Available from Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 67-16648

This thesis deals specifically with predicting the amplitude of waves generated on the interface between a gas and a liquid flowing parallel to each other in a horizontal channel. The theory involves solving the liquid Orr-Sommerfeld differential equation by asymptotic methods. The linear combination of the viscous and inviscid solutions which satisfies the boundary conditions is used to calculate the energy transferred from the mean liquid flow to the secondary or perturbation flow. In order to test the reliability of the theory, some experiments were performed in a horizontal, rectangular test channel. The amplitude of the waves generated on the interface between air and water were measured optically; variations in the intensity of a light beam passing through colored water corresponded to variations in the depth of the liquid. In order to compare the theory with the experiments, the conditions existing in the channel were used in the computer program to arrive at a predicted wave amplitude. Dissert. Abstr.

N68-35025 Texas Univ., Austin.
THE DRAG OF CYLINDERS ALL OR PARTIALLY IMMERSED IN A TURBULENT, SUPERSONIC BOUNDARY LAYER
John Conrad Westkaemper (Ph.D. Thesis) 1967 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-14900

The results are presented from an experimental study of the drag of right circular cylinders mounted on a flat plate. The tests were made in a wind tunnel at a nominal Mach number of 4.9. The boundary layer at the cylinder mounting position was turbulent. A floating element type drag balance was used to measure the drag of several cylinder configurations. These included: single cylinders of several lengths and diameters; two cylinders aligned in the stream direction with four different stream-wise spacings and several lengths; and single and double rows of cylinders of various lengths, arranged to simulate typical fastener patterns. The cylinder lengths ranged from 1/8 to 6 times the nominal boundary layer thickness. The drag of five common fastener heads was also measured. Cylinder drag was found to be strongly dependent on the extent of the boundary layer separation caused by each protuberance. Dissert. Abstr.

N68-35036 Houston Univ., Tex.
LIQUID FILM STRUCTURE AND DROP SIZE DISTRIBUTION IN TWO PHASE FLOW
Moye Wicks, III (Ph.D. Thesis) 1967 559 p
Available from Univ. Microfilms: HC $25.20/Microfilm $7.10 Order No. 67-16138

An investigation was made of downward gas-liquid flow in the film and dispersed regimes in a 6-inch × 3/4-inch channel. Special equipment was developed to measure probability density and level-crossing distribution of the interfacial waves, and size distribution of the entrained drops, over flow rates of liquid from 350 to 6000 pounds per hour, and over gas velocities from 0 to 280 feet per second. Several analytical models of different aspects of the film flow problem were developed. Interfacial structure data could be adequately represented by a log normal distribution of the difference between the film thickness and that of the continuous liquid sublayer. A new technique was developed to measure for the first time drop size distribution in a high speed flow field. The data obtained were satisfactorily correlated using the upper limit modification of the log-normal distribution function. Dissert. Abstr.

N68-35050 Michigan Univ., Ann Arbor.
VORTEX RINGS FORMED BY FREE SURFACE INTERACTION
Hugh Forrest Keedy (Ph.D. Thesis) 1967 151 p
Available from Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 67-15644

The behavior of vortex rings produced by free falling drops impinging upon a free surface is investigated. The drops, and consequently the rings that are formed, are of lesser, equal, or greater density than the surrounding fluid. There is a rapid transition from the drop to the ring form near the surface after which the ring descends in the surrounding fluid with decreasing velocity to a critical depth where the ring either stops or a new manifestation appears. The size and speed of the rings were determined experimentally and a simple mathematical model was constructed to predict these ring characteristics. The experimental observations were made both visually and photographically. The properties of the ring and other related phenomena are discussed and graphical representations of selected ring properties are presented. Dissert. Abstr.

N68-35086*# Southwest Research Inst., San Antonio, Tex.
FLOW-INDUCED VIBRATIONS OF A FLAT PLATE SUSPENDED IN A NARROW CHANNEL Final Report
Franklin T. Dodge and Arthur F. Muller Washington NASA Sep. 1968 62 p refs
(Contract NAS1-6714)
(NASA-CR-1186) CFSTI: HC $3.00/MF $0.65 CSCL 18I

Elastically restrained plates in narrow flow channels can vibrate excessively when the flow rate past them reaches some critical value. Because of the importance of this phenomenon in nuclear reactor design, an analytical study of such vibrations has been conducted. The theory is based upon the one-dimensional, hydraulic flow assumption and includes viscous pressure drops and energy losses at channel contractions and expansions. Since the vibrating plate influences the hydrodynamic loading and vice versa, the unknown flow velocity and plate vibration frequency are coupled and must be determined simultaneously. The results of the calculations for several typical flow situations show that the flow velocity necessary to induce vibrations decreases as the channel height-to-plate length ratio decreases; this is in substantial agreement with previous potential flow calculations although not with experimental data. Author

N68-35096*# Princeton Univ., N. J.
A METHOD OF CALCULATING COMPRESSIBLE TURBULENT BOUNDARY LAYERS
H. James Herring and George L. Mellor Washington NASA Sep. 1968 112 p refs
(Grant NGR-31-001-074)
(NASA-CR-1144) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The essential unknown quantity in a compressible turbulent boundary layer is shown to be the kinematic Reynolds stress, as in incompressible flow, and does not explicitly involve density fluctuations. Based on this, the incompressible turbulent viscosity proposed by Mellor is extended to include compressible flows. The same values of the three empirical constants, which were obtained solely from constant-property, constant-pressure experiments, are

also used. Without making any further assumptions beyond those related to the usual time averaged boundary layer equations, this system of equations has been programmed for numerical solution. Solutions have been compared to a considerable amount of constant-pressure data in the range from subsonic flows to flows with Mach numbers around 5.0 and the comparisons are quite favorable. Much less pressure gradient data are available but comparison was made to some axisymmetric flow data taken in a positive pressure gradient which indicated fairly good prediction of the boundary layer growth, while at the same time pointing up a systematic error in the detailed profile shape prediction in regions of finite longitudinal curvature. Author

N68-35104*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF OUTFLOW RESIDUALS IN INTERCONNECTED SPHERICAL TANKS
Harold J. Kasper and Robert J. Boyle Washington Sep. 1968 36 p refs
(NASA-TN-D-4828) CFSTI: HC$3.00/MF$0.65 CSCL 21H

An analysis is presented for predicting the propellant distribution during outflow of multiple-interconnected spherical tanks for possible space vehicle application. Analytical and experimental data are presented for four spherical tanks using water as the working fluid. The effects on final liquid residuals were determined for tanks that: (1) did or did not utilize crossflow lines between tanks for liquid level equilibration, (2) were initially equally or unequally loaded, and (3) had equal or unequal length outflow lines. The analysis adequately predicted the experimental residuals as well as the point at which crossflow lines ceased to be effective equilibration flow paths. Author

N68-35114*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID REORIENTATION IN SPHERES BY MEANS OF LOW-G ACCELERATIONS
Thomas L. Labus and William J. Masica Washington Oct. 1968 32 p refs
(NASA-TM-X-1659) CFSTI: HC$3.00/MF$0.65 CSCL 20D

An experimental drop-tower investigation of liquid reorientation in spherical containers was conducted from two initial interface conditions. One initial condition was a centrally located vapor bubble (the interface configuration in a zero-Bond-number environment). A second initial condition was an essentially flat interface (the configuration in a relatively high-Bond-number environment). Liquid reorientation was observed to be axisymmetric under both initial conditions. Qualitative observations of the gross effects of percent liquid volume and acceleration on the reorientation process are presented. Also included are graphic profiles of the liquid-vapor interface at selected times during the reorientation process. Author

N68-35117*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EQUILIBRIUM NORMAL-SHOCK AND STAGNATION-POINT PROPERTIES OF HELIUM FOR INCIDENT-SHOCK MACH NUMBERS FROM 1 TO 30
Walter B. Olstad, Jane T. Kemper, and Roger D. Bengtson Washington Sep. 1968 51 p refs
(NASA-TN-D-4754) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Charts are presented of the thermodynamic properties of helium, including the effects of ionization and particle interactions, for temperatures to 100,000°K and pressures from 10^{-7} to 10^{4} atmospheres. The properties behind the incident, standing, and reflected shocks and at the in-flight and shock-tube stagnation conditions are also presented for incident-shock Mach numbers from 1 to 30 and quiescent gas pressure from 10^{-7} to 1 atmosphere. Author

N68-35148*# Purdue Univ., Lafayette, Ind. Heat Transfer Lab.
IMPROVED FLUID DYNAMICS SIMILARITY, ANALYSIS AND VERIFICATION. PART 4: ACOUSTIC VELOCITIES IN TWO-PHASE MIXTURES OF SOME CRYOGENIC FLUIDS Final Report, 29 Jun. 1965–28 Jun. 1968
E. I. Griggs, E. R. F. Winter, and R. J. Schoenhals Jul. 1968 58 p refs
(Contract NAS8-20222)
(NASA-CR-61963) CFSTI: HC$3.00/MF$0.65 CSCL 20D

Calculated values of the acoustic velocity are presented graphically for single-component and two-component two-phase mixtures. Effects of void fraction or quality, temperature, and system pressure are illustrated. Acoustic velocity values were determined for two-phase mixtures of some of the cryogenic fluids used in propulsion systems of space vehicles. Three different analytical models were used: one model assumes thermodynamic equilibrium and is applicable only to single-component two-phase mixtures; the other two assume that the pressure disturbance travels through the medium without any change in the relative masses of the two phases, and these two are primarily applicable to two-component two-phase mixtures. For purposes of comparison, all three models were used in making calculations for single-component, two-phase mixtures of oxygen, nitrogen, and parahydrogen. Two-component, two-phase calculations were made with mixtures of oxygen and helium and hydrogen and helium. The effects of variations in quality or void fraction, temperature, and pressure are graphically shown. The acoustic velocity values presented for two-component mixtures should be useful for design purposes. Deviations in the various values for single-component mixtures indicate a need for experimental work to determine the analytical model which best describes the actual physical behavior. Author

N68-35165 Michigan Univ., Ann Arbor.
EVAPORATION AND INDUCED AIR FLOW IN SPRAYS PRODUCED BY SUPERHEATED WATER JETS
Henry Stanley Ostrowski (Ph.D. Thesis) 1966 298 p
Available from Univ. Microfilms: HC $13.50/Microfilm $3.85 Order No. 67-15732

The effect of nozzle diameter, injection pressure and temperature on the evaporation and induced air flow in sprays formed from superheated water jets was investigated. A new method was developed for direct measurement of the gas-phase composition in a spray. The high-speed double-exposure photographic method was used to obtain the drop-diameter and drop-velocity distributions in the sprays. The measured evaporation was found to be equal to or slightly greater than the adiabatic equilibrium evaporation for all the sprays. A theory is proposed to account for the observed behavior of the spray. Vapor-bubble-nucleation rates, vapor-bubble-growth rates and interface vaporization all have to be considered. Nozzle roughness was found to be an important variable influencing the break-up of a superheated jet. Models for the jet break-up are outlined for jets injected from smooth and rough nozzles. Dissert. Abstr.

N68-35190 National Lending Library for Science and Technology, Boston Spa (England).
THE CAVITATION SENSITIVITY OF A n-FOLD PROFILE CASCADE SYSTEM [DIE KAVITATIONSEMPFINDLICHKEIT EINES n-FACHEN PROFILGITTERSYSTEMS]
Ioan Anton and Octavian Popa 19 Aug. 1968 18 p refs In ENGLISH and GERMAN
(NEL-TT-1958) Available from Natl. Lending Library, Boston Spa, Eng.

Proposals are made for an original procedure for determination of cavitation sensitivity of n – fold cascade systems of arbitrary form. The procedure is based on the representation of the velocity range with the aid of Cauchy's integral formula for holomorphe and periodic functions. It will then be seen that the integral with a nucleus is arranged to derive the velocity function along the contour

of the profile arranged in the cascade. The solution of the problem will be achieved by the solution of several systems of integral equations of type Fredholm (second integral). The paper also includes the proof of the existence and uniformity of this solution.
Author

N68-35192# Laval Univ. (Quebec). Dept. of Mechanical Engineering.
THE DETERMINATION OF TURBULENT SKIN FRICTION Progress Report
J. Dickinson 5 Nov. 1967 236 p refs
(Grant DRB G-9550-23)
CFSTI: HC $3.00/MF $0.65

A general description is given of an experimental program aimed at determining turbulent skin friction. Details are included of a prototype skin friction balance which has been designed to allow an arbitrary displacement of the floating element head and thus permit an investigation of gap and displacement effects. A semi-empirical law of the wall is derived by considering an overlap region which can be described both by the wall law and a history-dependent velocity defect law. This law has the advantage of allowing the determination of local skin friction from velocity or Mach number data within any part of the wall law region.
Author

N68-35208# IIT Research Inst., Chicago, Ill. Dept. of Mathematics.
ELASTIC RECOVERY AND THE TOMS EFFECT—A SIMPLE MODEL
Gerald A. Tlapa and Barry Bernstein Jul. 1968 95 p refs
(Contract N00014-67-A-0210)
(TR-4; AD-673009)

The Toms effect (drag reduction by introduction of dilute polymer) is investigated analytically in terms of a properly invariant Maxwell model. A stability analysis of plane Poiseuille flow shows stability decreases with increasing elasticity. The change of character of the equations from parabolic to hyperbolic, which arises from introduction of even the slightest amount of elasticity, is shown to lead to dispersive wave phenomenon, whose influence of spreading out localized energy is investigated to obtain indications of explanations of the Toms effect.
Author (TAB)

N68-35208# California Univ., Berkeley. Div. of Applied Mechanics.
A NOTE ON MIXTURES
A. E. Green and P. M. Naghdi Apr. 1968 12 p refs Prepared in cooperation with Newcastle-Upon-Tyne Univ.
(Contract Nonr-222(69))
(AM-68-3; AD-673007)

The note contains a clarification concerning constitutive equations for mixtures and is supplementary to an earlier paper of the authors on interacting continua.
Author (TAB)

N68-35220# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
VOLUME INTEGRALS OF THE PRODUCTS OF SPHERICAL HARMONICS AND THEIR APPLICATIONS TO VISCOUS DISSIPATION PHENOMENA IN FLUIDS
Theodore P. Higgins and Zdenek Kopal Jul. 1968 29 p refs
Its Math. Note 563
(DI-82-0733; AD-673128)

The equations governing the conversion of kinetic energy into heat in moving viscous media are formulated as volume integrals of products of spherical harmonics. Although the formulation of the fundamental equations is classical, difficulties in the integration of certain products of generalized spherical harmonics over a sphere have permitted heretofore the treatment of only two cases. The closed form evaluation of eight fundamental types of definite integrals of the product of spherical harmonics, some of them new, or at least missing in the literature, makes possible for the first time the evaluation of these volume integrals in closed form for arbitrary order and index. Results are given for motions characterized by spheroidal symmetry and by toroidal symmetry.
Author (TAB)

N68-35229*# Purdue Univ., Lafayette, Ind. Heat Transfer Lab.
IMPROVED FLUID DYNAMICS SIMILARITY ANALYSIS AND VERIFICATION. PART 1: SIMILARITY STUDIES OF DISCHARGE OF LIQUID FROM CONTAINERS THROUGH ORIFICES AND TUBES Final Report, 29 Jun. 1965–28 Jun. 1968
A. R. Mulukutla, E. R. F. Winter, and R. J. Schoenhals Jun. 1968 206 p refs
(Contract NAS8-20222)
(NASA-CR-61964) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Proper scaling procedures and similarity relationships were stressed in this study. The instantaneous dimensionless mass flow rate was obtained as a function of six other dimensionless parameters. One-dimensional flow models yielded functional relationships for the dependence of the dimensionless mass flow rate on other pertinent parameters obtained from dimensional analysis. Analyses assuming quasi-steady flow and neglecting inertia effects yielded simple mathematical solutions which became inaccurate as the ratio of the container cross-sectional area to the discharge area is decreased. When inertial effects were included, second order nonlinear differential equations resulted which describe the dynamics of the process. These equations were numerically solved. A closed form solution was obtained for transient discharge through an orifice with constant discharge coefficient. When the Reynolds number is of the order of 1000 or larger, predictions of acceptable engineering accuracy can be obtained. A closed form solution in terms of elementary functions was obtained for discharge through a tube when the external pressure drop is much greater than the initial hydrostatic head in the container. Experiments with two different discharge tube entrance geometries were conducted in the ranges where inertia effects were significant.
K.W.

N68-35244# Ballistic Research Labs., Aberdeen Proving Ground, Md.
SHOCK TENSORS AND SHOCK POLARS
F. D. Bennett May 1968 27 p refs
(BRL-1399; AD-673107)

A refraction law for the velocity at an oblique shock in a compressible fluid is derived in dyadic form similar to that for refraction of light rays at an interface. The shock tensor embodies only the assumptions of conservation of mass and equality of tangential velocity components. Its eigenvalues and eigenvectors are easily found and interpreted. Given the shock inclination and density ratio, a quadratic equation in the ratio of the flow speeds can be found with flow turning angle as a parameter. Analysis of the two solutions shows that they lie on a circle in the polar plane, a result independent of the equation of state or other conservation laws. If density ratio is allowed to vary, a pencil of circles is generated in the hodograph plane; or, equivalently, a right elliptic cone with two nappes appears in the three-space formed when the density ratio coordinate is added at right angles to the hodograph plane. The further requirements that momentum and energy be conserved taken together with weak restrictions on the functional form of the equation of state are sufficient to permit the development of a general theory of shock polars. The allowed shock states are seen to lie on the space curve formed by intersection of a surface called the Hugoniot cylinder with the elliptic cone. The projection of this space curve on the hodograph plane is the shock polar. The theory is applied to the special case of a polytropic gas by way of illustration.
Author (TAB)

N68-35252*# Illinois Univ., Urbana.
DRAG ASSOCIATED WITH SEPARATED FLOW OVER TWO-DIMENSIONAL V-SHAPED NOTCHES UNDER TRANSONIC AND SUPERSONIC CONDITIONS
Ronald H. Howell and Helmut H. Korst Washington NASA Sep. 1968 87 p refs
(Grant NsG-13)
(NASA-CR-1132) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The wall geometry was limited to two-dimensional symmetric notches defined by specifying the length and angle of the notch. For any given notch geometry the free stream Mach number was the primary variable while the viscous effects, specified by the boundary layer momentum thickness and the length Reynolds number, were secondary variables. The Mach number ranged from 0.5 to 1.2 and at 2 , while the approaching boundary layer was always turbulent and reasonably well representative of fully developed shear layers along adiabatic flat plates with the momentum thickness Reynolds number from 7500 to 15000. To cover a wide range of boundary layer momentum thickness-to-notch-depth ratios, experiments were carried out with notches of various lengths and notch angles. Schlieren observations, pressure distributions, and direct drag force measurements were used in studying the viscid-inviscid flow phenomena controlling the drag of notches and the redevelopment of the boundary layer downstream of the disturbance. Author

N68-35264# Naval Postgraduate School, Monterey, Calif.
THE DEFLECTION OF PLANE TURBULENT JETS BY CONVEX WALLS
Turgut Sarpkaya Jun. 1968 54 p refs
(NPS-59SL8061A; AD-673249)

The effects of geometry and Reynolds number on the attachment of a jet to a convex wall and the mechanism of high pressure recovery in convex-walled amplifiers are investigated. The results are presented in terms of normalized parameters in a form suitable for comparison with theoretical results. Reasonably good agreement is obtained between the experimental results and those predicted theoretically by Gortler and Glauert, particularly for regions of flow away from the control port. The effects of the wall setback and control port are most pronounced in a region near the power nozzle where u sub m/u sub o attains values as high as 1.25. Author (TAB)

N68-35283# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PECULIARITIES OF THE DISTRIBUTION OF THE COEFFICIENT OF TURBULENCE IN THE BOUNDARY LAYER [NEKOTORYYE OSOBENNOSTI RASPREDELENIYA KOEFFITSIYENTA TURBULENTNOSTI V POGRANICHNOM SLOYE]
P. A. Vorontsov 8 Sep. 1967 33 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 167, 1965 p 80-97
(FTD-MT-66-156; AD-673181)

Various methods are considered for calculating the coefficient of turbulence along the vertical in a boundary layer. Methods for calculating the coefficient of turbulence at isolated levels in the boundary layer are analyzed. The coefficient of turbulence in ascending and descending flows is calculated for the case of fluctuations above various types of terrain. It is found that a characteristic feature of the coefficient of turbulence in the boundary layer is fluctuation due to pulsations in the structure of the air flow under various atmospheric conditions. Consideration is given to the effect which terrain and the structure of the underlying surface have on the distribution of the coefficient of turbulence. It is found that deformation of the air flow by forests during the summer causes a maximum in the coefficient of turbulence at an altitude of about 100 m which reaches an altitude of 200 m as the air moves over the densest part of the forest. A rather thick layer with thermal instability is observed during the daylight hours in July over semi-desert areas, while a temperature inversion with attenuation of turbulence was observed above cotton fields, particularly during irrigation. Typical profiles for the coefficient of turbulence are given. Several examples are given to illustrate calculation of profiles for the coefficient of turbulence in a boundary layer. Author (TAB)

N68-35311 National Lending Library for Science and Technology, Boston Spa (England).
THE ESTIMATION OF THE ADMISSION AND MOMENTUM OF THE KAPLAN-TURBINE FOR THE WORKING ORDER OF DEVELOPED CAVITATION [DIE SCHAETZUNG DER BEAUFSCHLAGUNG UND DES MOMENTES DER KAPLAN-TURBINE FUER DEN BETRIEBSZUSTAND ENTWICKELTER KAVITATION]
Arpad Fay 19 Aug. 1968 14 p In ENGLISH and GERMAN
(TT-NEL-1959) Available from Natl. Lending Library, Boston Spa, Engl.

Cavitation in the suction pipe aperture and its characteristic curve are discussed for Kaplan turbine construction, and a model was developed to estimate the alteration of momentum for the working order of developed cavitation. Characteristic curves were considered for values below the critical cavitation coefficient, and various types of characteristic curves were studied. For construction of curves the geometric parameters of the turbine, such as the head and momentum, were kept constant; and alteration of cavitation was produced by changing the internal pressure of the system. M.W.R.

N68-35334# Aro, Inc., Arnold Air Force Station, Tenn.
EXPERIMENTAL STUDY OF THE TURBULENT MIXING OF SUBSONIC AXISYMMETRIC GAS STREAMS Final Report, Jul. 1966-Oct. 1967
D. E. Chriss Arnold Eng. Devel. Center Aug. 1968 95 p refs
(Contract F40600-69-C-0001)
(AEDC-TR-68-133; AD-672975)

An experimental study of the turbulent mixing of subsonic axisymmetric gas streams was conducted. Hydrogen-air and air-air mixing systems were studied, and the velocity ratio (jet velocity/outer stream velocity) was varied from 2.4 to 6.3. Special emphasis is placed on (1) the centerline decay and radial profile shapes of composition, velocity, and total enthalpy and (2) the relationships between the turbulent transport of mass, momentum, and energy. The major conclusions drawn for this particular set of conditions are (1) for the hydrogen-air system the centerline decay decreases with increasing velocity ratio, (2) profile similarity of composition, velocity, and total enthalpy is a valid assumption, (3) there is a definite relationship between the transport of momentum and energy which is not compatible with a constant Prandtl number, and (4) unity Lewis number is a valid assumption. The experimental data obtained are tabulated for the benefit of other investigators. Author (TAB)

N68-35343# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE INFLUENCE OF A PRESSURE GRADIENT IN A FLOW ON THE DEVELOPMENT OF CAVITATION ZONES [VLIYANIE GRADIENTA DAVLENIYA V POTOKE NA RAZVITIE ZONY KAVITATSII]
K. K. Shalnev Sep. 1967 12 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Techn. Fiz. (Moscow), no. 1, 1961 p 108-109
(FTD-MT-24-162-67; AD-673168)

In hydrodynamic pipes designed for studying cavitation it has been noted that there is usually a pressure drop along the axis. Therefore, there has been a recent tendency to construct hydrodynamic pipes with a means for attaining constant pressure.

The article investigates the relationship between the pressure gradient and the length of the cavitation zone, demonstrating that the zone will be longer when the pressure gradient is weak. The experiments and results are described in detail. Author (TAB)

N68-35360#
DIFFERENCE METHOD OF NUMERICALLY SOLVING TWO-DIMENSIONAL NONSTATIONARY NAVIER–STOKES EQUATIONS FOR A COMPRESSIBLE GAS
I. Iu. Brailovskaia [1967] 10 p Transl. into ENGLISH from Vychisl. Metody i Programmir. (Moscow), no. 7, 1967 p 3–15
CFSTI: HC $3.00/MF $0.65

A difference method of computing two-dimensional nonstationary viscous compressible gas flows with variable viscosity and heat conduction coefficients is described herein. This method has been used to compute the stationary flow in a rectangular well caused by constant-velocity motion of the upper boundary. Generation of a stationary temperature, density, and velocity distribution occurred as a result of the build up. Author

N68-35361#
NONSTATIONARY FLOW AROUND A DEFORMABLE SURFACE (PLANE PROBLEM)
P. Kh. Derkach [1967] 9 p refs Transl. into ENGLISH from Gidroaeromekh. i Teoriia Uprug. (Khar'kov), no. 6, 1967 p 35–43
CFSTI: HC $3.00/MF $0.65

The motion of a nonstationary flow of an ideal compressible fluid over a deformable surface is considered herein. Its metric and metric tensor coefficients are constructed for the deformable surface. We have obtained the continuity equations and motion equations in curvilinear orthogonal coordinates in this metric for the compressible flow under whose effect the surface is deformed. The orthogonal coordinate system is inertialess since its origin is located on the surface being deformed accelerated. Author

N68-35375# Ballistic Research Labs., Aberdeen Proving Ground, Md.
INVESTIGATIONS OF FLOW PROPERTIES IN AN EXPANSION TUBE
Joseph H. Spurk, Edmund J. Gion, and Walter B. Sturek Jun. 1968 32 p refs
(BRL-1404; AD-673109)

Early experimental investigations of expansion tubes, which incorporate unsteady expansions to produce high Mach number, high energy flow, have pointed to two major difficulties: (1) flow contamination; and (2) lack of flow uniformity. The tests reported, which include (1) measurements of the number densities of the major impurities Fe, CN, Cr; (2) pitot pressure measurements in conjunction with interferometric measurements of free stream density; and (3) stagnation heat transfer measurement; show that the extent of these difficulties is largely overestimated. The effect of a diaphragm cutting device for the secondary diaphragm (the uncontrolled bursting of the diaphragm is thought to be responsible for the difficulties experienced) is found to have an adverse effect on the flow properties. Preliminary results from an expansion tube with the secondary diaphragm supported by a nozzle plate are, however, encouraging. Author (TAB)

N68-35385# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE USSR. NEWS. FLUID AND GAS MECHANICS
A. L. Genor et al 4 Oct. 1967 20 p refs Transl. into ENGLISH from the publ. "AN SSSR. Izvestiya. Mekhanika Zhidkosti i Gaza" USSR, no. 3, 1966 p 98–102, 117–119
(FTD-HT-67-181; AD-672906)

Contents: Investigation of discontinuity system in flow past star-shaped bodies; Investigation of detachment of laminar boundary layer on a cone at an angle of attack. TAB

N68-35400# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
THE INVISCID CHEMICAL NONEQUILIBRIUM FLOW BEHIND A MOVING NORMAL SHOCK WAVE
Dominic J. Palumbo and Ephraim L. Rubin Jun. 1968 31 p refs
(Contracts Nonr-839(34), Nonr-839(38))
(PIBAL-68-18; AD-673214)

A time-dependent numerical scheme is used to solve for the chemical nonequilibrium profile a normal shock wave in air. The steady state equations are also integrated using a fourth order Runge-Kutta technique and a comparison is made with the time-dependent calculation. The results agree within one percent except in the region close to the shock. In this region the profiles differ because the time-dependent technique allows calculation through the shock (which is several mesh points in width) and as a result some dissociation occurs. Author (TAB)

N68-35412# Iowa Inst. of Hydraulic Research, Iowa City.
ON A GENERAL SIMILARITY ANALYSIS FOR TURBULENT JET AND WAKE FLOWS
Eduard Naudescher Dec. 1967 50 p refs
(Contract NONr-1611(03))
(IIHR-106; (AD-672574)

The development of any inhomogeneous free-turbulence flow in an incompressible fluid is predicted through the use of a general self-preservation hypothesis, the analytical solutions are verified by comparison with experimental data on mean-flow and turbulence characteristics of plane and axisymmetric jets in coaxial parallel flow with and without confinement, of an axisymmetric jet in a cross flow, and of the wake behind a self-propelled body. Emphasis is placed on the distinct turbulence structure of the various flows as revealed by the different axial variations of a shear parameter relating turbulence shear to man velocity. The satisfactory predictions obtained by the new approach make it appear to have a more general application (e.g., to plumes and wall jets) than the examples chosen might imply. Author (TAB)

N68-35418# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURE OF REGION OF CAVITATION [STRUKTURA OBLASTI KAVITATSII]
K. K. Shal'nev 7 Jul. 1967 62 p refs Transl. into ENGLISH from Izv. Otdeleniya Tek. Nauk., no. 5, 1954 p 119–146
(FTD-MT-65-556; AD-673190)

An attempt is made to collect data of former investigations of the structure of cavitation of constructive elements and to report the results of the present investigations of the structure of the region of breakdown cavitation for a round profile. The work gives details of photographic and audio experiments and results. Description of the various sounds noted is included. Author (TAB)

N68-35421# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
PITOT-PRESSURE MEASUREMENTS WITH RAPIDLY TRAVERSING PROBES IN THE WAKE OF A SPHERE IN A DIVERGING HYPERVELOCITY STREAM
Denis Wai-Man Tsao Apr. 1968 166 p refs
(Contract Nonr-225(65); Arpa Order-322)
(SUDAAR-341; AD-672589)

Apparatus and test conditions; transducer-galvanometer response and correction; source-flow effects and correction; data reduction and results. Author (TAB)

N68-35423 California Univ., Berkeley. Div. of Aeronautical Sciences.

APPLICATION OF STATISTICAL MOMENTS IN THE REDUCTION OF SUPERSONIC MOLECULAR BEAM DATA

William E. Amend Jun. 1968 204 p refs
(Contract Nonr-222(45) Grant NSF GK-1297)
(AS-68-4; AD-672560)

A statistical method of inverting T-O-F data from supersonic molecular beam systems is described. The effect of the modulator waveform on the T-O-A curve was studied to find a suitable approximation to this function along with the optimum conditions for securing data. The idealized shutter function was used and a data processing method was developed by applying the method of statistical moments to the governing integral equation. This permits the distribution of velocities in the molecular source to be determined when its form is known beforehand from the physics of the flow field. A nozzle-beam system with an extremely high pumping speed was used to secure T-O-F data from along the axis of a nitrogen free-jet expansion at points for which the measured beam intensities were 70 to 85 percent of the predicted values and the gas was only moderately rarefied. These data were reduced by applying to T-O-F analysis for the ellipsoidal distribution function predicted by the Willis–Hamel theory. The theory of Ashkenas and Sherman was used to estimate the viscous effects and arrive at a quasiisentropic theory which fit the data quite well over most of the jet axis. finally, the results of the study were compared to those of previous investigators to illustrate that the Berkeley system is capable of coming much closer to ideal operation than other existing facilities. Author (TAB)

N68-35436# Air Force Systems Command Wright-Patterson AFB, Ohio. Foreign Technology Div.

A NEW METHOD OF CAVITATION TESTING OF HYDROTURBINE MODELS [NOVAYA METODIKA KAVITATSIONNYKH ISPYTANIY MODELEY GIDROTURBIN]

A. D. Pernik 6 Oct. 1967 23 p Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. i Proyektnokonstruktorskiy Kotloturbinnyy Inst. (Leningrad), no. 46, 1964 p 25–40
(FTD-MT-24-242-67; AD-672696)

The author proposes a method for cavitation testing hydraulic turbine models. This method makes it possible to simplify experimentation and to give a better explanation for turbine operation under conditions of cavitation. The method was developed at the hydroturbine Division of the Cavitation Laboratory at the Central Scientific Research Design and Planning Boiler and Turbine Institute imeni I. I. Polzunov. Author (TAB)

N68-35440# Aerospace Corp., El Segundo, Calif. Technical Operations.

FREE-MOLECULAR DRAG FOR FLOW ALONG A CONCAVE CYLINDRICAL SURFACE ORIENTED AT ARBITRARY ANGLES-OF-ATTACK

J. Daniel Stewart May 1968 78 p refs
(Contract F04695-67-C-0158)
(TR-0158(3305)-6; SAMSO-TR-68-257; AD-672983)

The local shear stresses and drag are determined for a concave cylindrical segment oriented at an angle of attack. The enclosed half-angle and angle of attack are varied from 0 to 90 deg and the flow velocity lies in the plane of symmetry. The gas particles are assumed to be diffusely reflected from the surface and completely accommodated to the wall temperature. No end-effects are included. A complete analysis of the effects of multiple surface collisions is given and the various components of drag are compared and discussed. Analytical solutions are obtained under the assumption of hyperthermal flow and the results are compared with the results of the analysis which includes all thermal motion. For sufficiently large values of the normal component of the speed ratio the simplified results for the hyperthermal case may be used. It is also found that the total drag is very nearly equal to the total drag for a flat plate with the same projected chord area, the difference being attributed to the reflected particles not having a cosine distribution when they cross the chord plane. Author (TAB)

N68-35443# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TURBULENCE IN WAKES OF IDENTICAL VELOCITY [TURBULENTNOST' V SPUTNYKH POTOKAKH ODINAKOVOY SKOROSTI]

V. R. Kuznetsov 13 Sep. 1967 14 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), v. 5, no. 4, 1965 p 763–767
(FTD-HT-67-302; AD-673230)

The turbulence transfer from a turbulent stream discharging from a plane nozzle into a liminar stream moving at the same velocity is considered. The model is based on the mixing processes with eddy diffusion occurring across the flow interface. Based on arguments that the mixing coefficient (probability of turbulence at a given point) has a normal distribution and that the eddies interact only weakly among each other, it is assumed that the distribution of pulsation energy can be described by the normal diffusion equation. Author (TAB)

N68-35475# Aeronautical Research Council (Gt. Brit.).

THE MEASUREMENT OF SKIN FRICTION IN SUPERSONIC FLOW BY MEANS OF HEATED FILM GAUGES

B. J. Bellhouse and D. L. Schultz London HMSO 1968 11 p refs Supersedes Rept.-1002; ARC-27402, see N66-15735
(ARC-RRM-3490; Rept.-1002; ARC-27402) CFSTI: HC $3.00/MF $0.65

The application of heated thin film gages to the measurement of mean skin friction in compressible flow is described. It is shown that the calibration of the gages is independent of Mach number, at least up to M = 3, provided the fluid properties are calculated at the appropriate film temperature. The gages are calibrated by reference to surface tubes and also by comparison with the theoretical solution of Spalding and Chi. Author (ESRO)

N68-35480# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DEFORMATION OF AXES OF PARALLEL STREAMS DURING THEIR INTERJECTION [DEFORMATSIYA OSEY PLOSKO-PARALLEL'NYKH STRUY PRI IKH VZAIMOEZHEK-SIY]

B. G. Khudenko 8 Aug. 1967 19 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), Issue 2, 1966 p 90–99
(FTD-MT-67-80; AD-673177)

A method of approximate calculation of the deformation of the axes of two plane-parallel turbulent gas jets as a result of their mutual ejection is proposed. The deformation of a jet of ideal fluid is considered. The coefficient of under-pressure between the jets in the initial segment, the main segment, and where the segments join is determined. It is found that the under-pressure in the region corresponding to the main segment increases rapidly with distance from the nozzle. The model which was adopted does not provide for a continuous variation in the coefficient of under-pressure in a potential flow. The deformation of a gas jet is examined. Author (TAB)

N68-35499 National Lending Library for Science and Technology, Boston Spa (England).

DETERMINATION OF THE DUST CONTENT IN FLOWING GASES WITH SUCTION PROBES

M. Bohnet 23 Jul. 1968 14 p refs Transl. into ENGLISH from Chem.-Ing.-Tech. (Berlin), v. 39, no. 16, 1967 p 972–977 Presented at VDI Comm. Meetings, Frankfurt am Main, 21 Apr. 1967
(TRANS-1008) Available from Natl. Lending Library, Boston Spa, Engl.

The absolute solid content in flowing gases is determined almost exclusively by suction and analysis of a partial gas stream. Prerequisite for an accurate measurement by the partial stream method is the isokinetic suction of the partial gas stream at the places representative of the solid content of the gas stream. With suction at different rates measuring errors occur, which increase with growing variation of the suction rate from the channel rate and the size of the solid particles. The calculation of the flowing field near the probe opening makes the calculation of the movement tracks of the solid particles possible and therefore a statement on the size of the measuring error. For additional correction of the measuring result, a diagram is set which is easy to handle. Author

N68-35509 National Lending Library for Science and Technology, Boston Spa (England).
PAPER ON THE THEORETICAL DETERMINATION OF CURRENT FLOW WITH CAVITATION IN RADIAL BLADE CASCADES
Ljubisav Krsmanovic [1968] 14 p refs Transl. into ENGLISH from a Yugoslav Paper
(NEL-TT-1956) Available from Natl. Lending Library, Boston Spa, Engl.

In this paper we describe the progress of determination of the velocity field and distribution at the blades of a rotating radial blade cascade (assuming non-compressible and viscosity-less fluidity and latent current flow at the cascade) by application of the analytical functions of the complex variables. Limiting conditions for profile contours were determined under varying headings, beginning with procedure up to maximum rate of flow and up to fusing speed respectively. It is possible to determine the commencing point and extent of the cavitation zone, as well as the transition point with total cavitation by analysis of the pressure distribution diagrams. These methods are suitable for the choice of pump and turbine wheels leading to cheaper and more rapid experimental investigations into cavitation installations. Author

N68-35521# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
VORTEX STREETS IN STABLY STRATIFIED FLUIDS
Yih-Ho Pao, M. E. Callahan, and G. K. Timm Jul. 1968 33 p refs
(D1-82-0736)

Periodic vortices (vortex street) formed behind a circular cylinder in a flow of a stably stratified fluid with constant upstream velocity and density gradient are investigated experimentally. The vortices are elliptic in shape, and the vertical spacings between them decrease rapidly along the wake. The vortex street collapses into internal waves far downstream. The onset of the vortex street is determined in terms of a stability parameter σ (= $Ri^{1/2}/Log_{10}$ (Re/40), Re > 40), a function of Reynolds number Re and Richardson number Ri. It is found that for $\sigma > 1$, the flow is extremely stable and there are no periodic vortices formed in the wake. As σ decreases to less than unity ($\sigma < 1$), periodic vortices begin to appear in the wake. Author

N68-35670# Aerospace Corp., El Segundo, Calif. Lab. Operations.
EFFECT OF INCOMPLETE ACCOMMODATION ON THE SLIP COEFFICIENT Technical Report, Jan.–Feb. 1968
Melvin Epstein Apr. 1968 30 p refs
(Contract F04695-67-C-0158)
(TR-0158(3240-20)-12; SAMSO-TR-68-266; AD-672962)

The sensitivity of the value of the slip coefficient obtained from different models of the wall boundary condition was determined by a kinetic theory analysis of the problem of uniform shear flow (Kramers problem). Solutions were obtained for two models of the wall boundary condition. The first model is that of Maxwell, in which it is assumed that a fixed fraction of the incident particles reflects diffusely and the remainder reflects specularly. The second model is a special case of a more general model previously developed by the author to account for the fact that the nature of the reflection process depends on the velocity of the impinging particle. These solutions were used for determination of the variation of the slip coefficient with the gas-surface interaction parameters. At a fixed value of the tangential momentum accommodation coefficient, the two models may yield significantly different values of the slip coefficient. It is found that the slip coefficient corresponding to the new model is always greater than or equal to the value corresponding to Maxwells model. The two values differ by a factor of as much as 8/pi at small values of the accommodation coefficients. Author (TAB)

N68-35602*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
A NEW METHOD FOR CALCULATING TURBULENT BOUNDARY LAYERS [EINE NEUE METHODE ZUR BERECHNUNG TURBULENTER GRENZSCHICHTEN]
Karl-Otto Felsch Washington NASA Oct. 1968 13 p refs Transl. into ENGLISH from Wiss. Z. (East Ger.), v. 16, no. 4, 1967 p 1185–1190
(Contract NASw-1692)
(NASA-TT-F-11915) CFSTI: HC$3.00/MF$0.65 CSCL 20D

Development of a method for calculating incompressible two-dimensional turbulent boundary layers. Proceeding from the (theoretically sound) special case of an equilibrium boundary layer, an empirical relation is derived for boundary layers with arbitrary pressure gradients. The general behavior of turbulent boundary layers is treated as a deviation from the equilibrium state. It is shown that this approach makes it possible to obtain extensive information concerning the behavior of turbulent boundary layers. Author

N68-35612#
RAREFIED GAS FLOW NEAR THE FORWARD STAGNATION POINT OF A BLUNT BODY AT HYPERSONIC VELOCITIES
V. S. Avduevskii and A. V. Ivanov [1967] 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. i Gaza (USSR), no. 3, 1968 p 26–34
CFSTI: HC$3.00/MF$0.65

The transition region in rarefied gas flow near the forward stagnation point of a blunt hypersonic body is analyzed for changes in the shock thickness, in the boundary layer, in the whole compressed layer ahead of the body, and in the gas parameters near the body as functions of change in Reynolds and Mach numbers. Gas dynamic computations show that a decrease in Reynolds number results in growths of shock and boundary layer thicknesses, where the shock thickness increased more rapidly; however, an isentropic flow section was maintained in the compressed layer at first. As rarefaction increases the shockwave thickness and boundary thickness grow simultaneously, but the latter more rapidly. At the time the boundary layer joins the shock the shockwave thickness is twice the boundary layer thickness. Further combined thickening of shockwave and boundary layer results in their merging. Comparison of stagnation flow analysis with heat flux measurements near the forward stagnation point of a blunt body in low Reynolds number domain shows that a deviation from laminar continuum flow formulas at $R_s \approx 100$ can be attributed to shock layer interaction with the boundary layer. G.G.

N68-35631 National Lending Library for Science and Technology, Boston Spa (England).
SELF SUSTAINED OSCILLATIONS IN HEATED TWO PHASE FLOWS
J. Boure and A. Mihalla [1968] 15 p refs Transl. into ENGLISH from Houille Blanche (France), no. 5, 1967 p 551–558
(C.E.-TRANS-4820) Available from Natl. Lending Library, Boston Spa, Engl.

The physical processes likely to provide a theoretical explanation for oscillations observed in heated two-phase flows are reviewed, especially as regards nuclear reactors. The design of a model based entirely on the density effect and its application to the calculation of critical oscillation conditions are described, a digital solution is discussed and compared with experimental data. Author

N68-35690*# Volt Information Sciences, Inc., Washington, D. C.
ON THE LENGTH OF THE RELAXATION ZONE OF IONIZATION BEHIND A STRONG SHOCK WAVE FRONT IN THE AIR
S. A. Losev and V. A. Polyanskiy Goddard Space Flight Center, Greenbelt, Md. NASA 7 Oct. 1968 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 182, no. 1 p 75–76
(Contract NAS5-12487)
(NASA-CR-97011; ST-AM-10761) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The structure of the relaxation zone behind a shock wave front in the air is studied by computer so as to ascertain the reasons of the increase of the zone of nonequilibrium ionization. It is found that a substantial maximum is observed in the concentration of molecular ions forming as a result of associative ionization and charge-exchange. Author

N68-35735# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
LAMINAR, TRANSITION, AND TURBULENT FLOWS OF STABLY STRATIFIED FLUIDS OVER BARRIERS
Yih-Ho Pao Jul. 1968 10 p refs
(TM-55)

In order to increase understanding of geophysical flows over barriers in which the stable stratification plays an important role, a survey was made of some experimental, theoretical, and numerical studies on laminar, transition, and turbulent flows of stably stratified fluids over barriers. Laminar flow was investigated over a very thin body represented by a finite thin flat plate, a simple bluff barrier in the form of a circular cylinder, and a wedge mounted on a flat plate to simulate wind over a mountain ridge. Stable stratification was found to delay flow separation in a study of separated flow behind a circular cylinder in a flow of stably stratified fluid. Turbulent flows behind bluff barriers were investigated by using a circular cylinder or a grid towed in stratified salt water. M.W.R.

N68-35777# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
ON THE INTERACTION OF A LAMINAR HYPERSONIC BOUNDARY LAMINAR HYPERSONIC BOUNDARY LAYER AND A CORNER EXPANSION WAVE
Philip A. Sullivan Aug. 1968 28 p refs
(UTIAS-TN-129; AD-673869)

A simple method of calculating the extent of the interaction of a corner expansion wave with a hypersonic boundary layer is presented. Arguments are presented to suggest that for small turning angles the principal feature of the flow is the interaction of the boundary layer and the expansion wave downstream of the corner. The net result is a large increase in the thickness of the boundary layer, and a greatly extended region of pressure decay. Numerical results based on the cold wall or local similarity approximation are given. Author (TAB)

N68-35810 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATION OF COMBUSTION IN A FLOW [ISSLEDOVANIYA GORENIYA V POTOKE]
A. V. Talantov 19 Aug. 1968 18 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekhn. (Kazan), no. 40, 1967 p 55–65
(SMRE-TRANS-5599) Available from Natl. Lending Library, Boston Spa, Engl.

In investigating the physico-chemical processes of combustible flow in connection with developing jet aircraft, attention was focused on the influence of such factors as the composition of the mixture, and the speed, turbulence, pressure, and temperature of the flow; flight altitude and speed; flame propagation speed, burning time, and extent of the combustion zone; and heat emission and stabilization limits. A simplified model is given for calculating direct-flow combustion chambers and semiempirical expressions are derived for describing the phenomena. A literature survey was conducted and the peculiarities and discrepancies which have developed in this scientific field are pointed out. A report bibliography is included. M.G.J.

N68-35823*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID VAPOR INTERFACE CONFIGURATIONS IN TOROIDAL TANKS DURING WEIGHTLESSNESS
Eugene P. Symons and Kaleel L. Abdalla Washington Oct. 1968 13 p refs
(NASA-TN-D-4819) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An experimental investigation was conducted in the Lewis Research Center drop tower facility to study the isothermal liquid-vapor interface configuration in a toroidal tank during weightlessness for a 0°-static-contact-angle liquid. Results are presented for a range of liquid volumes in tanks normally positioned horizontally and also for tanks mounted at angles to the gravity field prior to the weightless test. The angle tests simulated the effect of nonaxial maneuvers on the initial position of the liquid-vapor interface before entering weightlessness. Three basic interface configurations were observed and were shown to be dependent on tank mounting angle and liquid volume and to be independent of tank size. Author

N68-35825*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN EXPERIMENTAL STUDY OF THE BEHAVIOR OF A SLOSHING LIQUID SUBJECTED TO A SUDDEN REDUCTION IN ACCELERATION
Louis E. Toole (Chrysler Corp.) and Leon J. Hastings 6 Aug. 1968 67 p refs
(Contract NAS8-4016)
(NASA-TM-X-53755) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The behavior of a liquid column oscillating in the fundamental antisymmetric mode and subjected to a sudden reduction in acceleration has been experimentally investigated. The amplitude and configuration of the liquid vapor interface, shifts in the liquid center of gravity, damping of the liquid motions, and the period of oscillation under the reduced gravity environment were examined using six-inch diameter scale model S-IVB LH_2 tanks. In addition, the effectiveness of a single ring baffle used as a propellant control device was evaluated. Author

N68-35913*# Illinois Univ., Chicago. Dept. of Energy Engineering.
A SIMPLIFIED STATISTICAL DESCRIPTION OF TURBULENT CHEMICALLY REACTING FLOWS (COUETTE FLOW)
Paul M. Chung May 1968 46 p refs
(Grant NGR-14-012-012)

(NASA-CR-97103; TR-E-13) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A simplified turbulence model has been constructed which describes the statistical behavior of the fluid elements which comprise the larger eddies, and which contain the chemically reactive species. The theory was then employed, as a primary test, to analyze the turbulent Couette flow of a chemically inert fluid. In the analysis, it was shown that the present theory as applied to a chemically inert fluid is self-containing up to the dissipation function. An experimental value of dissipation function for a pipe flow, for lack of the same for a Couette flow, was adapted and used in the analysis. A comparison of the present theoretical results with the available experimental data on Couette flow showed a satisfactory agreement between the two. A simple relationship has been derived between the dissipation function and the other variables of the theory which would render the present theory completely self-containing for the chemically inert single-component flow. Author

N68-35917# RAND Corp., Santa Monica, Calif.
APPLICATION OF THE BHATNAGAR-GROSS-KROOK MODEL: A CAUTIONARY EXAMPLE
D. Roger Willis Aug. 1968 11 p refs Presented at 6th Intern. Symp. on Rarefied Gas Dyn., Cambridge, Mass., 22–26 Jul. 1968 Submitted for publication
(Contracts Nonr-222(45); DAHC15-67-C-0141)
(P-3908; AD-673826)

The nearly free molecular drag of a highly cooled blunt body in a hypersonic stream is predicted using the method of Knudsen iteration. The simple BGK model is used for the collisions. The predicted drag coefficient differs substantially from that reported previously. The main cause of this disagreement is thought to be a lack of validity of the simple BGK model for a highly nonequilibrium flow. Author (TAB)

N68-35930# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CONDITION FOR THE FORMATION OF THE SECONDARY SHOCK WAVE IN HYPERSONIC FLOW
Zhang Han-Zin 19 Sep. 1967 16 p refs Transl. into ENGLISH from Li Hsueh Hsueh Pao (Peking), v. 8, no. 4, 1965 p 316–322
(FTD-HT-67-460; AD-673786)

The conditions were studied for formation of a secondary shock wave in hypersonic flow around a blunt-nosed cone. Airflow behind the cone was taken as motion around a concave surface. A coordinate system was used to explain the discontinuity in the flow layer, taking into account direction of flow, entropy, Mach number, velocity of flow, air pressure, and geometric parameters. Author (TAB)

N68-35984# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Hypersonic Facilities Dept.
TURBULENT BOUNDARY LAYER SKIN FRICTION, HEAT TRANSFER AND PRESSURE MEASUREMENTS ON HYPERSONIC INLET COMPRESSION SURFACES Final Report, Jan. 1967–Jul. 1968
M. O. Ryder, Jr. Wright-Patterson AFB, Ohio AF Flight Dyn. Lab Jul. 1968 143 p refs
(Contract F33615-67-C-1203)
(CAL-AF-2389-Y-3; AFFDL-TR-68-102; AD-672836)

An experimental study of turbulent boundary layer flow, under the influence of adverse pressure gradients typical of hypersonic inlets, was conducted on a two-dimensional and an axisymmetric model each instrumented with skin friction, heat transfer and pressure gages. Tests were conducted over a Mach and Reynolds number rage of 6.74 to 11.37 and 1,050,000 per ft. to 29,300,000 per ft., respectively. These test conditions produced boundary layer transition on the forward portions of the models without resorting to artificial trips. It was possible to attain a fully turbulent boundary layer before the start of the adverse pressure gradient region for most of the axisymmetric model tests but for most of the two-dimensional tests, transition was not completed until after the start of the pressure gradient. A comparison of the pressure data with the inviscid pressure distribution was made and good agreement is generally found indicating very little change in effective model shape due to boundary layer growth. This result is a consequence of the large model size relative to the boundary layer thickness, i.e. high Reynolds number flows over large models. An important conclusion resulting from this program was that turbulent boundary layers can negotiate large adverse pressure gradients without separating. Comparison with some existing laminar boundary layer data indicate that a turbulent boundary layer can negotiate adverse pressure gradients at least an order of magnitude greater than those gradients which will separate a laminar layer. Author (TAB)

N68-35993# Washington Univ., Seattle. Electrical Engineering Dept.
PROPAGATION OF SPHERICAL WAVE IN NON-STATIONARY MEDIA
Frederick P. Carlson and Akira Ishimaru Jun. 1968 34 p refs
(Contract AF 19(628)-5879)
(AFCRL-68-0333; TR-125; SR-6; AD-673889)

The paper considers spherical waves propagating in a non-stationary turbulent media. The method of analysis uses the Rytov approximation and the perturbation technique of J. B. Keller. The resulting integral equations are solved by spectral techniques. The results are then compared with other known plane and spherical wave homogeneous and locally homogeneous results. They are then applied to examine the optimum aperture and resolution results of D. L. Fried. It is concluded that it is essential to allow for a distribution of turbulence in a region. In addition, the optimum aperture results for vertical propagation show a marked dependence on the height of the observer and the parameters which describe the distribution of turbulence in the region. The fact that optimum apertures continue to result is considered important and useful. Author (TAB)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-34810# Alaska Univ., College. Geophysical Inst.
HOURLY VALUES OF THE AURORAL ELECTROJET ACTIVITY INDEX AE FOR 1962
T. N. Davis and Y. S. Wong Oct. 1967 84 p ref
(Grants NSF GA-492; NSF GP-5540)
(UAG-R-197)

A plot of the AE (Auroral Electrojet) index and tabulations of AE, AU, AL, and Ao indexes for 1962 are presented based on the hourly-average scalings of the H trace from 11 auroral zone observatories. A single reference value was obtained for each station for each month, and all data are presented in universal time. At any epoch, the records from only two observatories determine the value of AE. The index AE at any epoch is defined by the distance or separation between the upper (AU) and lower (AL) envelopes at the epoch; and these envelopes provide a measure of the maximum eastward and westward electrojet currents at any time. The AE index is a direct measure of the total maximum amplitude of the currents in the auroral zone ionosphere. The Ao index, which represents the displacement of the midpoint of the AU and AL from the reference level at a particular time, is an

approximate measure of the equivalent zonal current, regardless of whether the current exists in the ionosphere or in the magnetosphere. M.W.R.

N68-34811# Alaska Univ., College. Geophysical Inst.
HOURLY VALUES OF THE AURORAL ELECTROJET ACTIVITY INDEX AE FOR 1963
Carol Echols, Y. S. Wong, and T. N. Davis Mar. 1968 84 p refs
(Grants NSF GA-492; NSF GP-5540)
(UAG-R-200)

Auroral Electrojet (AE) hourly values and tabulations of AE, AU, AL, and Ao indexes are presented for 1963. For abstract see N68-34810.

N68-34812# Alaska Univ., College. Geophysical Inst.
HOURLY VALUES OF THE AURORAL ELECTROJET ACTIVITY INDEX AE FOR 1964
T. N. Davis and Y. S. Wong Sep. 1967 84 p ref
(Grants NSF GA-492; NSF GP-5540)
(UAG-R-198)

Auroral Electrojet (AE) hourly values and tabulations of AE, AU, AL, and Ao indexes are presented for 1964. For abstract See N68-34810.

N68-34835# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NUMBER 187
4 Sep. 1968 102 p Transl. into ENGLISH from the Russian Report
(JPRS-46347) CFSTI: HC$3.00/MF$0.65

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N68-34838# Joint Publications Research Service, Washington, D. C.
OCEANOGRAPHY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 187 4 Sep. 1968 p 25–43 (See N68-34835 22-13)

Sino-Soviet publications in the field of oceanography are reported. Cited are news items on a photoelectric transparency meter; techniques used in selecting water samples for determining strontium 90 in sea water near the mouths of rivers; techniques for improving the design of automatic and standard current methods; a method for determining nitrates in sea water; the initiation of the underwater workweek for the first scientific crew of the Chernomor; the initiation of a new expedition of the scientific research ship Akademik Kurchatov to the Pacific Ocean which focuses on investigations of the reasons for the high productivity of the area and studies of the fish population in the area; an underwater Z variometer; and a monograph on coasts of the Pacific Ocean. Also included are abstracts of scientific articles among which are cited studies of the hydrological structure of the Gulf of Aden; the propagation of water masses in the North Atlantic; reduction and oxidation processes in the Black Sea; statistical processing of bottom relief data; Soviet studies of geomagnetic field in oceans; primary production in the Arabian Sea during summer monsoon in May through July 1966; similarity criteria in the optics of turbid media; convective mixing and water circulation in the Black Sea; statistical characteristics of waves in the Indian Ocean; and ice observations in Scotia Sea. S.C.W.

N68-34839# Joint Publications Research Service, Washington, D. C.
TERRESTRIAL GEOPHYSICS
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 187 4 Sep. 1968 p 44–70 (See N68-34835 22-13)

Sino-Soviet publications in the field of terrestrial geophysics are reported. Cited are news items on a symposium devoted to study the nature of the Mohorovicic discontinuity which was held at Zagreb in March 1966; a calculator for solving inverse gravimetric problems; Soviet and Japanese studies of the earth's crust in the southern part of Kokkaido Island; a multipurpose gravimeter (i.e., for measuring gravity on land, at the bottom of water reservoirs, and in submarines; and a scientific conference on the hydrometerology of Azerbaydzhan, Dagestan, and the Caspian Sea which was held in Baku in October 1967. Included are abstracts of scientific articles among which are cited studies of the dynamics of the lithosphere in the transition region continent-ocean; the structure of crust and mantle in transition zones; electrical properties of rocks in variable electromagnetic fields; a new method for reducing gravity in mountainous regions; applications of reverse microseismic logging in seismic wave studies; seismicity in Turkmenistan; applications of spatial spectra in studying laws of electromagnetic sounding; earthquakes occurring in selective areas of the Soviet Union; the crustal structure in the Labrador Sea; and geomagnetic field measurements in the Caspian Depression. S.C.W.

N68-34840# Joint Publications Research Service, Washington, D. C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 187 4 Sep. 1968 p 71–85 (See N68-34835 22-13)

Sino-Soviet publications in the area of upper atmosphere and space research are reported. Cited are news items on the launching of Kosmos-234; a drill invented for use under conditions of weightlessness; the launching of Kosmos-235; the role of geodesy in outer space exploration; plans for the establishment of an Institute of Atmospheric Optics at Tomsk; and plans for Poland to produce scientific research equipment for Soviet Kosmos satellites. Included are abstracts of scientific articles among which are cited studies of electron density dependence on altitude in D-region; methods for determining ozone vertical distribution in the earth's atmosphere; the role of nonadiabatic losses of particles in the inner belt; the influence of forests on medium radio wave propagation; ionization of the lower ionosphere by cosmic rays; hydrogen concentration at altitudes of 300 to 600 km; the effect of character of trajectory measurements on correction of spaceflight trajectories; critical heat fluxes during forced movement of fluid during weightlessness; lunar radio emission in the millimeter and submillimeter band; space-time distribution of some magnetic disturbances; magnetic field variations in the auroral zone; and approximation methods for determining parameters of satellite rotation and orientation. S.C.W.

N68-34866# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
COSMIC RAY NM-64 NEUTRON MONITOR DATA – 8. MONTHLY GRAPHS, JANUARY–APRIL 1968 [DONNEES RECUEILLIES PAR DETECTEURS NEUTRONIQUES DE RAYONS COSMIQUES, MODELE NM-64 (8)]
J. F. Steljes Jun. 1968 68 p
(AECL-3140) CFSTI: HC$3.00/MF$0.65

Uncorrected and barometer corrected results from the cosmic ray stations in Canada using equipment maintained by AECL are given in tabular form for the period from January to April, 1968.

Normalized graphs are given for the period January 1968 to April 1968. A warning about defective barometer vacuum at two stations is included. Author

N68-34862 Arizona Univ., Tucson.
STRATIGRAPHY AND STRUCTURE OF THE CLEOMEDES QUADRANGLE OF THE MOON
Alan Bruce Binder (Ph.D. Thesis) 1967 137 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 67-12296

The stratigraphy of the Cleomedes quadrangle is discussed. Evidence is given which indicates that deposition of the mare units is not limited to the Imbrium Period. Several types of small craters (diameters 10 km) whose morphology and geological setting indicate that they may be volcanic in origin are discussed. Infrared colorimetric observations of several units were made to determine if this type of observation could be used as a mapping aid. Though the infrared observations are presently limited in usefulness by instrumental limitations, colorimetric observations can be used to help differentiate among, and correlate separate units which have been mapped visually. An estimate of the lunar time scale is given based on the stratigraphic mapping and crater counts obtained from several stratigraphic maps. It is concluded that most of the units which have been mapped lack well defined time boundaries and should be classified as rock-stratigraphic units rather than time-stratigraphic units. Dissert. Abstr.

N68-34883# Alaska Univ., College. Geophysical Inst.
SUMMARY OF NOCTILUCENT CLOUD DATA FROM ALASKA, CANADA, GREENLAND, ICELAND, AND THE SOUTHERN HEMISPHERE FOR THE YEARS 1885–1966
Benson Fogle Jul. 1967 137 p refs
(Grant NSF GA-431)
(UAG-R-191)

Validity criteria for noctilucent cloud (NLC) observations are explained, and names, codes, and coordinates of all stations in the Northern Hemisphere which participated in the observations are given. Nightly summaries of NLC observations and detailed data on the NLC sightings are presented in tabulated form based on reports from these stations in Alaska, Canada, Greenland, and Iceland. A catalog of photographs of 84 Northern Hemisphere NLC displays from 1957 through 1966 is presented. The network of observation stations in the Southern Hemisphere is briefly described. Only a few NLC reports were made for the Southern Hemisphere over the period 1885 to 1964. The well documented NLC occurrences reported since 1965 are also presented in a table. K.W.

N68-34941 New Hampshire Univ., Durham.
ELECTRON DENSITY MEASUREMENTS IN THE LOWER IONOSPHERE BY A ROCKET BORNE RADIO PROPAGATION METHOD
Lee Edward Larson (Ph.D. Thesis) 1967 146 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-15798

This thesis reports the results of a series of rocket flights whose primary purpose was to to determine the electron density of the lower ionosphere. In addition on two flights solar radiation fluxes at 2 to 12, 1216 to 1450 A. were measured. Preliminary to the experimental study, a review of pertinent aspects of the theory of ionospheric formation is presented. The electron density instrumentation was designed to determine the Faraday rotation of linearly polarized waves at 1.005 and 3.385 MHz which were sent from ground-based transmitters to recievers in the rocket payload. The ultraviolet radiation experiment consisted of suitable photoionization chambers coupled with a current to voltage amplifier, and a Geiger tube was used to detect the 2 to 12 A. X-rays This instrumentation is described in detail. Dissert. Abstr.

N68-34969 Washington Univ., Seattle.
TRANSPORT OF TRACE SUBSTANCES WITHIN THE LOWER STRATOSPHERE AND UPPER TROPOSPHERE
Paul Halborg Gudiksen (Ph.D. Thesis) 1967 162 p
Available from Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 67-14174

This thesis describes the results of an air sampling program designed to study stratospheric-tropospheric air exchange processes within the region of the middle latitide tropopause discontinuity. Filter samples of radioactive particulate debris and carbon dioxide samples for carbon-14 analysis were collected by aircraft within the lower stratosphere and upper troposphere over the Northwestern United States. High values of cesium-137 activity were measured within the lower cyclonic stratosphere, while much lower values were observed within the anti-cyclonic stratosphere. The low concentrations of these trace substances within the anti-cyclonic stratosphere are due to tropospheric air entering the stratosphere within this region. On the basis of the results of the numerical transport model presented in this thesis it was concluded that the substantial eddy diffusion processes within this region could readily transport air laterally from the upper equatorial troposphere into the anti-cyclonic stratosphere. Dissert. Abstr.

N68-35010 Saskatchewan Univ., Saskatoon.
MORPHOLOGY OF QUIET AURORAL DISPLAYS IN THE VICINITY OF THE EARTH'S MIDNIGHT MERIDIAN
John Earle Black (Ph.D. Thesis) 1967 174 p
Available from Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 67-11410

During the IGY a number of all-sky auroral cameras operated in West-Central Canada. These cameras extended from 60°N to 75°N (geomagnetic) in latitude. Auroral displays during quiet geomagnetic conditions were examined in detail. The displays, at any instant, were found to consist of what are here termed auroral components. Three types of components were observed. The north component consisted of bright and/or rayed arcs, and its average position was 68.4°N. The south component consisted of faint diffuse auroral forms such as surfaces and arcs, and its average position was 64.9°N. Within a degree north of the south component bright rayed bands were sometimes found. These constituted an activated component. From studies of the components at West-Central Canada their appearance and behaviour were deduced for a large longitude region on the Earth's darkside. Dissert. Abstr.

N68-35011 Saskatchewan Univ., Saskatoon.
A STUDY OF THE TWILIGHT AIRGLOW EMISSIONS OF SODIUM, LITHIUM AND POTASSIUM
William Andrew Gault (Ph.D. Thesis) 1967 218 p
Available from Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 67-16528

The twilight airglow emissions of sodium, potassium and lithium were observed simultaneously at Saskatoon for 15 months during 1965–6; in addition, lithium was observed for 11 months during 1962–3. Two birefringent photometers and one wedge-filter photometer were used. The potassium emission produces a rather complex twilight curve, with a minimum often appearing between solar depression angles of 6 and 7°. It is believed that this is caused by terrestrial absorption in the oxygen A-bands. A potassium-vapour absorption cell was used to verify that the emission is due to potassium. Great differences exist between the seasonal brightness variations of the emissions. Sodium shows a January maximum of 4 to 5 kR., a June minimum of 0.8 kR, and a fairly smooth transition. Lithium shows sharp autumn and winter peaks up to 130 R., rising above a fainter background which has a minimum in June. Potassium shows no definite seasonal variation; the average brightness is 130 R. Dissert. Abstr.

N68-35040# Alaska Univ., College. Geophysical Inst.
HOURLY VALUES OF THE AURORAL ELECTROJET ACTIVITY INDEX AE FOR JULY–DECEMBER 1967
T. N. Davis, Carol Echols, and Y. S. Wong Mar. 1968 48 p ref
(Grants NSF GA-492; NSF GP-5540)
(UAG-R-194)

Auroral electrojet(AE) hourly values and tabulations of AE, AU, AL, and Ao indexes are presented for July through December 1967. For abstract see N68-34810.

N68-35041# Alaska Univ., College. Geophysical Inst.
HOURLY VALUES OF THE AURORAL ELECTROJET ACTIVITY INDEX AE FOR 1958
Y. S. Wong and T. N. Davis Jul. 1967 77 p ref
(Grant NSF GA-492)
(UAG-R-192)

Auroral electrojet(AE) hourly values and tabulations of AE, AU, AL, and Ao indexes are presented for 1958. For abstract see N68-34810.

N68-35042# Alaska Univ., College. Geophysical Inst.
HOURLY VALUES OF THE AURORAL ELECTROJET ACTIVITY INDEX AE FOR 1959
Y. S. Wong, Carol Echols, and T. N. Davis Oct. 1967 84 p ref
(Grants NSF GA-492; NSF GP-5540)
(UAG-R-195)

Auroral electrojet(AE) hourly values and tabulations of AE, AU, AL, and Ao indexes are presented for 1959. For abstract see N68-34810.

N68-35043# Alaska Univ., College. Geophysical Inst.
HOURLY VALUES OF THE AURORAL ELECTROJET ACTIVITY INDEX AE FOR 1960
Y. S. Wong, Carol Echols, and T. N. Davis Mar. 1968 84 p ref
(Grants NSF GA-492; NSF GP-5540)
(UAG-R-199)

Auroral electrojet(AE) hourly values and tabulations of AE, AU, AL, and Ao indexes are presented for 1960. For abstract see N68-34810.

N68-35044# Alaska Univ., College. Geophysical Inst.
HOURLY VALUES OF THE AURORAL ELECTROJET ACTIVITY INDEX AE FOR 1961
Y. S. Wong, Carol Echols, and T. N. Davis Oct. 1967 84 p ref
(Grants NSF GA-492; NSF GP-5540)
(UAG-R-196)

Auroral electrojet(AE) hourly values and tabulations of AE, AU, AL, and Ao indexes are presented for 1961. For abstract see N68-34810.

N68-35059*# Volt Information Sciences, Inc., Washington, D. C.
POLAR DISTURBANCES AND THE FIELD OF THE MAGNETOSPHERE [POLARYARNYYE VOZMUSHCHENIYA I MAGNITOSFERNOYE POLE]
B. E. Bryunelli Greenbelt, Md. NASA Goddard Space Flight Center 24 Sep. 1968 4 p refs Transl. into ENGLISH from Russian Presented at the Intern. Symp. on the Phys. of the Magnetosphere, Washington, D. C., 3–13 Sep. 1968
(Contract NAS5-12487)
(NASA-CR-96887; ST-GM-AI-10757) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Polar disturbances, the field of the magnetosphere, and the polar substorm currents in the presence of auroral current jets are considered in a brief assessment of ionospheric currents. It is concluded that the true distribution of currents in the ionosphere differs sharply from the commonly known scheme. Author

N68-35065# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR DECEMBER 1967 FROM WOOMERA, SOUTH AUSTRALIA
Apr. 1968 27 p
(WRE-CPD-1967/12(W)) CFSTI: HC $3.00/MF $0.65

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for December, 1967. Author

N68-35066# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR NOVEMBER 1967 FROM WOOMERA, SOUTH AUSTRALIA
May 1968 27 p
(WRE-CPD-1967/11(W)) CFSTI: HC $3.00/MF $0.65

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for November, 1967. Author

N68-35110# Alaska Univ., College. Geophysical Inst.
NOTES ON TOPOGRAPHIC FACTORS AFFECTING THE SURFACE WIND IN ANTARCTICA, WITH SPECIAL REFERENCE TO KATABATIC WINDS; AND BIBLIOGRAPHY
K. B. Mather and G. S. Miller Jun. 1967 173 p refs
(Grant NSF GA-900)
(UAG-R-189)

The topography of the environs of Antarctic stations plays an important part in determining prevailing surface winds. This report is mainly a collection of notes on the topographic factors likely to influence the surface wind. Particular attention is paid to plateau slope and the exposure of the site to katabatic drainage. Wind roses are shown for most stations, in relation to the plateau contours. Meteorological and sastrugi observations made on traverses are used to supplement the station data. Some classifications and systematics of Antarctic data are tabulated, including seasonal variations of wind speed and temperature, the diurnal variation of wind speed, wind frequency versus wind direction, the deviation of the predominant wind direction from the azimuth of plateau slope, the wind direction near the front of ice shelves, and the mean annual wind speed in relation to temperature. The overall flow pattern of the surface winds of Antarctica is shown. A comprehensive bibliography (169 entries) lists source material for the notes on station topography and winds, and articles relating particularly to katabatic winds. Author

N68-35111# Alaska Univ., College. Geophysical Inst.
VARIABLES INVOLVED IN DESCRIPTIONS OF WORLDWIDE AURORAL MORPHOLOGY
T. Neil Davis Jun. 1967 40 p refs Presented at the NATO Advanced Study Inst. on Aurora and Airglow, Keele, Engl. Submitted for publication
(Grant NSF GA-900)
(UAG-R-187)

Any aspect of auroral morphology is a function of three spatial and one temporal variable and therefore is difficult to describe adequately on a two dimensional sheet of paper. Emphasis is given here to examination of the variables and fixed parameters employed in descriptions of auroral morphology. Author

N68-35151*# Teledyne Industries, Inc., Garland, Tex.
SEISMIC EFFECTS OF SONIC BOOMS
Tom T. Goforth and John A. McDonald Washington NASA Sep. 1968 130 p refs
(Contract NAS1-6342)
(NASA-CR-1137) CFSTI: HC$3.00/MF$0.65 CSCL 08K

Earth particle velocities produced by sonic booms were recorded at Edwards Air Force Base, California, the Tonto Forest Seismological Observatory near Payson, Arizona, and the Uinta Basin Seismological Observatory near Vernal, Utah. Analysis of the field data indicates that the seismic effects of sonic booms are largely confined, laterally, to the boom pressure envelope and vertically to the upper few meters of the earth's surface. The maximum particle velocity associated with a sonic boom is in response to the rapid pressure changes of the leading and trailing edges of the acoustic N-wave. Comparison of peak particle velocities recorded at Edwards Air Force Base show good agreement with theoretically-predicted values. Empirical relations developed from the recorded data indicate that peak particle velocity is linearly related to the maximum positive overpressure of the N-wave. On hard, well-consolidated rock, each pound per square foot of overpressure produces about 75 microns per second peak particle velocity. On more loosely-consolidated rock, each pound per square foot of overpressure produces about 100 microns per second peak particle velocity. Author

N68-35157 National Lending Library for Science and Technology, Boston Spa (England).
THE PROPAGATION OF CENTIMETRIC, MILLIMETRIC AND SUB-MILLIMETRIC RADIO WAVES IN THE EARTH'S ATMOSPHERE [RASPROSTRANENIE SANTIMETROVYKH, MILLIMETROVYKH I SUBMILLIMETROVYKH RADIOVOLN V ZEMNOI ATMOSFERE]
S. A. Zhevakin and A. P. Naumov Sep. 1968 51 p refs Transl. into ENGLISH from Izv. Vysshikh Ychebnykh Zavedeniya, Radiofizika (USSR), v. 10, no. 9, 1967 p 1213–1243
(RTS-4696) Available from Natl. Lending Library, Boston Spa, Engl.: 40s

Theoretical and experimental studies dealing with the absorption coefficient and refractive index of the earth's atmosphere were reviewed in relation to the centimeter, millimeter, and submillimeter bands. Principal attention was on those mechanisms of absorption and refraction by molecules of atmospheric gases that determine the transmission characteristics of radio waves in the neutral and clear atmosphere. Studies were reviewed relating absorption of microwaves by monomer water vapor, for which errors in absorption coefficients are due to inability to accurately measure widths of the spectral lines. Experimental values of half-widths of spectral lines and dipole moments of monomer water vapor are tabulated from a number of references. Absorption of radio microwaves by dimer water vapor in the atmosphere is discussed in terms of measurement techniques employed, as is absorption by molecular oxygen. M.W.R.

N68-35179*# National Aeronautics and Space Administration, Washington, D. C.
ON THE COMPUTATION OF SOLAR ELEVATION ANGLES AND THE DETERMINATION OF SUNRISE AND SUNSET TIMES
Harold M. Woolf (Natl. Meteorol. Center) Sep. 1968 23 p refs Prepared for NASA by the Natl. Meteorol. Center
(NASA-TM-X-1646) CFSTI: HC$3.00/MF$0.65 CSCL 04A

The complete procedure for precise computation of solar elevation angle as a function of latitude, longitude, data, and time is given. Construction of a graphical aid for determining times of sunrise and sunset, with a precision of one minute, as functions of latitude, longitude, date, and altitude is described. Author

N68-35213# Stanford Research Inst., Menlo Park, Calif.
CONCENTRATIONS OF CARBON MONOXIDE AND ORGANIC GASES IN ARCTIC ATMOSPHERES Final Report, 1 May 1967–30 Apr. 1968
Leonard A. Cavanagh Apr. 1968 29 p refs
(Contract N00014-67-C-0515)
(AD-672356)

Investigations have been conducted on the concentrations of carbon monoxide and hydrocarbons of low molecular weight in clean Arctic air, and their patterns as functions of meteorological parameters have been interpreted. Author (TAB)

N68-35214 National Lending Library for Science and Technology, Boston Spa (England).
IS IT POSSIBLE TO CONTROL THE CLIMATE OF THE ARCTIC?
P. M. Borisov [1968] 21 p refs Transl. into ENGLISH from Akad. Nauk, Priroda (Moscow), no. 12, 1967 p 63–73 In ENGLISH and RUSSIAN
(M-7397) Available from Natl. Lending Library, Boston Spa, Engl.

Possibilities of improving the climate of the Arctic region are discussed in terms of suggestions that have emanated from a number of studies and re-creating the way in which natural climatic ameliorations have taken place. A general review of climatology from the Cretaceous era to today is offered, and some explanations are included for the climatic changes that have occurred. Direct flow of water between the Arctic and neighboring oceans is considered, and attention is given to a scheme for heating the Arctic waters by creating a direct flow of warm Atlantic water through the Arctic basin into the Pacific. Various stages in climate amelioration are noted; and a stage during which it will be possible to grow trees along the Arctic coastlines is considered feasible. The transfer of between 250,000 to 280,000 km^3/year of water would be required to reach this stage, which is considered possible. The need for international cooperation is noted. M.W.R.

N68-35234# Los Alamos Scientific Lab., N. Mex.
STROKE AND SPACE RESOLVED SLIT SPECTRA OF LIGHTNING
T. Robert Connor 2 Aug. 1968 37 p refs
(Contract W-7405-ENG-36; ARPA Order 631)
(LA-3754-ADD; AD-672916)

Twenty-four stroke-resolved slit spectra of lightning taken in 1966 are presented, one of which is also the first space-resolved slit spectrum of a return stroke. These split spectra unambiguously show that the lightning return-stroke channel is a strong continuum source and that the continuum observed in the slitless spectra in 1965 is real and not the result of line radiation scattered from natural backgrounds such as clouds, haze, or rain. Author (TAB)

N68-35240# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
BIBLIOGRAPHY ON SNOW, ICE AND FROZEN GROUND, VOLUME 22
Jun. 1968 238 p
(CRREL-12; AD-672756)

The bibliography on snow, ice and frozen ground with abstracts, provides USA CRREL with a current and comprehensive coverage of basic and applied scientific research on snow, ice, and frozen ground, as well as living and working in polar regions and other cold areas. Author (TAB)

N68-35260# Boeing Scientific Research Labs., Seattle, Wash.
THE CYCLOTRON RESONANCE AMPLIFICATION OF WHISTLERS IN THE MAGNETOSPHERE

Harold B. Liemohn Apr. 1968 32 p refs
(D1-82-0713; AD-673030)

Electromagnetic waves and charged particles in the magnetosphere may exchange energy through the cyclotron resonance interaction. If the nonthermal particles have an anisotropic pitch angle distribution, VLF and ULF signals may be amplified over well-defined broad bands of frequencies. An analytic solution of the dispersion equation is obtained for a particular anisotropic distribution which simulates magnetospheric conditions, and the instability is found to be unique and convective. Frequency spectra of the net power transfer along whistler paths are presented for a class of distributions which are thought to be typical of quiescent conditions in the magnetosphere. Finally, the theory is applied to experimental amplitude measurements of a VLF whistler event to illustrate its potential for estimating the phase space distribution of nonthermal particles in the magnetosphere. Author (TAB)

N68-35287 National Lending Library for Science and Technology, Boston Spa (England).
ON THE QUASIBIENNIAL RECURRENCE EFFECTS IN THE STRATOSPHERIC PROCESSES OF HIGH AND MIDDLE LATITUDES
L. A. Rjazanova [1968] 14 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 78, 1967 p 100–106
(M-7411) Available from Natl. Lending Library, Boston Spa, Engl.

Results of rocket soundings and 10 mb contour charts are presented for high and middle latitudes of the northern hemisphere. Analyses reveal the quasibiennial periodicity features in the zonal flow in the stratosphere. These are clearly to be seen in the countour field in late winter and early spring at the time when the summer anticyclonic vortex becomes established, in the trajectories of the 10 mb circumpolar depression, in the summer time temperatures and in the autumnal changes in the contour field. Author

N68-35327# Alaska Univ., College. Geophysical Inst.
A PROGRAM OF GROUND BASED AURORAL OBSERVATIONS COORDINATED WITH SIMULTANEOUS SATELLITE MEASUREMENTS Final Report, 1 Oct. 1964–31 Dec. 1966
G. J. Romick and J. L. Hook Nov. 1967 71 p refs
(Contract Nonr-3010(06))
(AD-672848)

In order to participate in a coordinated satellite and ground-based observation program, the Geophysical Institute of the University of Alaska equipped optical and radio ground stations along a geomagnetic meridian in the northern auroral zone. The polar orbiting satellite, instrumented with a multitude of electron and proton particle detectors was in orbit for three days from November 9 to 11 U.T. 1965. The satellite had an inclination of 94 degrees with an initial apogee of 300 km and perigee of 160 km. The satellite was earth-oriented and was held to about 1 degree attitude during its life. The period during which the satellite was in orbit was magnetically very quiet. Usable coordinated data were obtained during the first day. After that, the auroras observed from the only clear station (College) were too far north to be quantitatively useful. A detailed analysis of the data obtained on the first day has provided basic data on the auroral hydrogen arc. Author (TAB)

N68-35337# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
IONOSPHERIC RESEARCH Final Report, 3 Mar. 1967–28 Feb. 1968
Thomas A. Seliga Feb. 1968 29 p refs
(Contract F19628-67-C-0301)
(AFCRL-68-0178; AD-672827)

The report contains research directed toward the investigation of the lower ionosphere. Specific emphasis was placed on the design, conduction and analysis of rocket-borne A.C. conductivity probes and radio wave propagation experiments. These objectives have formed the basis for the studies outlined in this report. As stated in Section I, the present contract has been one of related efforts underway in the Ionosphere Research Laboratory during the period of interest. It is a continuation of Part B of the original contract (AF 19(604)-8012) as well as the work under Contract AF 19(628)-4050, pertaining to D and lower E-region rocket measurements. Following certain introductory material an outline of each investigation performed under the contract is given. These are related to former efforts described in the Final Report. The problems outlined fit under the broad categories of electromagnetic theory studies, ionospheric phenomena, ground based and rocket equipment of development and the physics of ionospheric formation. Author (TAB)

N68-35352# Miami Univ., Coral Gables, Fla. Inst. of Atmospheric Science.
THEORETICAL STUDIES OF THE ATMOSPHERIC BOUNDARY LAYER Final Report
Mariano A. Estoque and Chandrakant M. Bhumralkar Jun. 1968 57 p refs Paper No. 3
(Contract DA-AMC-28-043-67-G2)
(ECOM-67G2-F; AD-673201)

A two-dimensional time dependent numerical model of the atmospheric boundary layer is formulated and used to investigate various characteristics of air motion when a change occurs in roughness and/or temperature characteristics of the underlying surface. The integrations have been carried out for steady-state situations also. The model incorporates the effects of penetrative convection, diabatic influence associated with small-scale eddy diffusion, and pressure effects induced by horizontal nonuniformity of terrain in temperature and roughness. The results show that warm surfaces do not necessarily increase the height of internal boundary layers in the vicinity of surface discontinuity. The effects of discontinuity are quite appreciable at large fetches downwind from the discontinuity. Author (TAB)

N68-35354# Dugway Proving Ground, Utah. Meteorological Div.
FIELD USE OF INTENSITY OF TURBULENCE, RICHARDSON'S NUMBER AND EDDY DIFFUSIVITY TO MAKE DIFFUSION CALCULATIONS
Albert W. Waldron, Jr. Mar. 1968 61 p refs
(DPG-T68-106; AD-673131)

The report consists of five sections. Section I is an introduction. Sections II through V treat related subjects. Section II demonstrates the accuracy to be expected from diffusion dosage calculations which make use of direct measurements of intensity of turbulence and wind speed. Section III uses a derived expression for the relationship of Richardsons number to intensity of turbulence, and the resulting dosage calculations are discussed. Section IV tests the universality of the derived relationship of Richardsons number to intensity of turbulence. Section V relates the variance of vertical wind speeds at different sites and altitudes to Richardsons number. Section V further treats some of the problems involved in calculating and using eddy diffusivity to make dosage calculations and suggests a way of calculating eddy diffusivity at heights between the top of the surface boundary layer and the gradient wind level. Author (TAB)

N68-35385# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
ATMOSPHERIC TIDAL MOTION IN THE 90 TO 120 KILOMETER HEIGHT REGION

Arthur Woodrum and Carl G. Justus Jun. 1968 222 p refs
(Contract AF 19(628)-4781)
(AFCRL-68-0309; SR-1; AD-672825)

A detailed derivation of the existing linearized atmospheric tidal theory is given. In comparison with the theory, experimental results are determined from wind data which were obtained from chemical release trails in the 90 to 120 km height region. The rocket wind data were analyzed by two methods: (1) a geometrical method which was devised by using the physical properties of the wind motion under consideration, and (2) a generalized least squares procedure which was developed by G. V. Groves. Both analyses separated the prevailing, diurnal, and semidiurnal wind components from the total winds. In addition, an analysis was performed involving pairs of wind profiles which led to a profile of the irregular winds versus height in the height region near 100 km. Author (TAB)

N68-35370# American Science and Engineering, Inc., Cambridge, Mass.
ROCKET IR HORIZON DATA Final Report, 15 May 1966–15 Mar. 1968
Lester A. Sodickson and Robert L. Becker 21 Jun. 1968 56 p refs
(Contract AF 19(628)-5964)
(ASE-1950; AFCRL-68-0300; AD-672991)

7-30 micron emission spectra of the earth and atmosphere near the geometric horizon have been obtained with a rocket-borne telescope/interferometer. The Co_2 (15 micron) and the ozone (9.7 micron) bands are observed in absorption when viewing the earth, the Co_2 band is also seen in emission when the field-of-view grazes the earth. Author (TAB)

N68-35431# Uppsala Univ. (Sweden). Seismological Inst.
SEISMIC BODY WAVES AND SURFACE WAVES Annual Summary Report, 1 Jan.–31 Dec. 1967
Markus Bath, James H. Whitcomb, and Enders A. Robinson Jan. 1968 143 p refs
(Contract AF 61(052)-702)
(REPT.-59; AFCRL-68-0374; ASR-2; AD-672809)

In 1967 research was continued on the application of array data processing techniques to a network of ordinary seismograph stations in Fennoscandia. Extension of previous investigations of short-period P-waves to include the whole of Fennoscandia and also studied S-waves by a Fennoscandian array. Theoretical research has also proceeded, and has included such items as deduction of synthetic seismograms from explosion sources under more realistic conditions. Author (TAB)

N68-35437# Utah Univ., Salt Lake City. Upper Air Research Labs.
LANGMUIR PROBES FOR DETERMINING IONOSPHERIC PARTICLE DENSITIES AND TEMPERATURES
Karl G. Seljaas Jun. 1968 107 p refs
(Contract F19628-67-C-0275)
(UU68-2; SR-1; AFCRL-68-0306; AD-672808)

The development of a rocket-borne Langmuir probe system for ionospheric research is described. Particular emphasis is placed on D- and E-region electron temperature and density measurement techniques. Present theory is discussed and found to be unsatisfactory for the rocket probe in the collision dominated D region. The development of the electronic instrumentation is cataloged and the results from a number of rocket flights are analyzed. The probe system that is recommended consists of a function generator that biases the electrode alternately between the electron acceleration region and the positive ion acceleration region and a high input impedance logarithmic amplifier capable of compressing five decades of data in the 0 to 5-volt output range. Currents can be monitored over the ambient temperature range of -10C to +50C. Author (TAB)

N68-35490# Kiruna Geophysical Observatory (Sweden).
JSSG SPACED RECEIVER MEASUREMENTS Final Scientific Report
Ludwik Liszka Apr. 1968 77 p refs
(Contract F61052-67-C-0072)
(AFCRL-68-0365; AD-672811)

The height of ionospheric irregularities was measured by several laboratories belonging to the Joint Satellite Studies Group, using spaced receiver techniques. The method of analysis and results obtained are presented. Author (TAB)

N68-35531# Joint Publications Research Service, Washington, D. C.
USE OF POLYETHYLENE TRANSOSONDES FOR STUDYING WIND STRUCTURE IN THE UPPER TROPOSPHERE
A. S. Masenkis and V. A. Patsayeva 24 Sep. 1968 6 p refs
Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 73, 1967 p 113–115
(JPRS-46505)

This article describes a method for investigating wind flow in the upper troposphere using polyethylene transosondes. The balloons carried a device which terminated drift two hours after the ascent, thus guaranteeing that they would not drift beyond the confines of a particular region in the USSR. Author

N68-35555# Council for Scientific and Industrial Research, Pretoria (South Africa).
AN INVESTIGATION INTO THE EFFECT OF TEMPERATURE CHANGE ON THE F REGION ELECTRON DENSITY DISTRIBUTION IN THE SOUTH ATLANTIC GEOMAGNETIC ANOMALY
D. G. Torr and Marsha R. Torr 1967 19 p refs
(CSIR-263) CFSTI: HC $3.00/MF $0.65

A possible explanation for the decrease in f_0F_2 observed by various workers at stations in the South Atlantic geomagnetic anomaly is put forward. It is shown that the neutral gas temperature distribution in the atmosphere can be represented by a hyperbolic function, which gives a much better fit to actual conditions than the usual linear temperature gradient. The theory of layer formation is revised using this function to represent the temperature. To calculate values of the electron density N in the F region under the influence of ambipolar diffusion a second order nonlinear differential equation must be solved, and a method is developed for doing this. Finally it is shown that when a realistic function is used to represent the neutral gas temperature, an increase of about 400°K in the exospheric temperature decreases N_{max} by a factor of 2 to 3, if the intensity of ultraviolet radiation beyond the atmosphere and the solar zenith angle are kept constant. The conclusion is drawn that this is due to an increase in the loss rate, because of a corresponding increase in the number densities of the constituents N_2 and O_2. Author

N68-35561# Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
AN EXPERIMENTAL STUDY OF WIND-WAVE INTERACTIONS
Richard Ives Hires May 1968 181 p refs
(Contract Nonr-4010(11))
(TR-37; Rept.-68-5; AD-672797)

An experimental investigation was made to determine the ratio of the wave-supported shear stress, phi sub w: to the total shear stress on the water surface, phi sub o. The experimental conditions were designed to correspond to those required for the application of the viscous shear flow theory of wave generation proposed by Brooke Benjamin (1959) and Miles (1962b). The experiments were performed in a wind-wave tunnel, 48 x 3-1/2 x 2 feet, with a mean water depth of 1-1/2 feet. The wind in the 6 in. air space above the water was fully-developed turbulent channel flow. The mean center-line wind speed, U sub xi, was kept

constant at 1.20 m/s during all measurements made with the wind blowing over the water. An artificially generated, single-component, wave train of small amplitude provided a known, initial perturbation of the water surface with which the wind could interact. The range of wave frequencies investigated was from 4.0 to 5.2 cps. Wave measurements were made with capacitance wave probes, wind measurements with hot-wire anemometers. . . . Author (TAB)

N68-35583# Naval Radiological Defense, Lab., San Francisco, Calif.
DEVELOPMENT OF OCEAN DIFFUSION MODELS
S. Z. Mikhail and L. R. James Jan. 1968 23 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-CR-68-3532) CFSTI: HC $3.00/MF $0.65

The assumptions, approximations and basic equations used in developing, evaluating and programming two ocean diffusion models are described. The first model assumes an instantaneous point source release while the second considers a slowly dissolving radioactive source. Preliminary results for the instantaneous case are presented and future plans for continuing the development and evaluation of these two models are detailed. . . Author (NSA)

N68-35629*# Volt Information Services, Inc., Washington, D. C.
NUMERICAL METHOD OF CALCULATING THE DOPPLER EFFECT AND THE REDUCED DIFFERENCE OF DOPPLER FREQUENCIES OF RADIOWAVES COHERENTLY EMITTED FROM ARTIFICIAL EARTH'S SATELLITES
D. S. Lukin and V. A. Shkol'nikov Goddard Space Flight Center, Greenbelt, Md. NASA 30 Sep. 1968 8 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 3, 1968 p 389–394
(NAS5-12487)
(NASA-CR-97013; ST-RWP-AI-10754) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A numerical method is proposed for calculating the Doppler effect and the reduced difference of Doppler frequencies of two coherent radiowaves emitted from artificial Earth's satellites or from geophysical rockets in a three-dimensional inhomogeneous magnetoactive medium. The results of the calculation of the reduced difference of Doppler frequencies of two coherent radiowaves (f_1 = 20 mc, f_2 = 90 mc) along the orbit of a "Kosmos"-type AES are presented for a spherically stratified and horizontally inhomogeneous ionosphere for a two-dimensional case. The effect of horizontal gradients of electron concentration on the reduced difference of Doppler frequencies is demonstrated by means of numerical calculations. Author

N68-35630*# Volt Information Sciences, Inc., Washington, D. C.
CONCENTRATION OF HYDROGEN IN THE UPPER ATMOSPHERE OF THE EARTH IN THE 300–600 km ALTITUDE RANGE ACCORDING TO IONOSPHERIC DATA
M. N. Fatkullin Goddard Space Flight Center, Greenbelt, Md. NASA 10 Oct. 1968 6 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 3, 1968 p 407–410
(Contract NAS5-12487)
(NASA-CR-97012; ST-AM-AI-10763) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Utilizing the results of rocket and satellite investigations of the ionic composition of the outer part of the F_2-region of the ionosphere and of measurements of atomic oxygen concentration at corresponding heights, estimates are presented of hydrogen concentration in the 300–600 km altitude range during solar activity minimum. Comparison is also made between the estimated values of hydrogen concentration and the results of direct measurements. Author

N68-35648# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Institut fuer Flugfunk und Mikrowellen
DESCRIPTION OF A DIGITAL COMPUTING PROGRAMME FOR THE DETERMINATION OF TROPOSPHERIC AND IONOSPHERIC DOPPLER FREQUENCY ERRORS [BESCHREIBUNG EINES DIGITALER RECHENPROGRAMMS ZUR ERMITTLUNG DES TROPOSPHAERISCHEN UND IONOSPHAERISCHEN DOPPLERFEHLERS]
D. Giesner and P. Edenhofer Jul. 1968 50 p refs In GERMAN; ENGLISH summary
(DLR-MITT-68-15) CFSTI: HC $3.00/MF $0.65

Assuming the principles of geometrical optics, a formula is derived which allows to calculate the Doppler shift of a monochromatic wave radiated from a movable transmitter in the presence of an inhomogenous, isotropic medium. This formula is specialized in case of a satellite on elliptic orbit around a spherical earth, the atmosphere of which is inhomogeneous only in radial direction. For the bearing error ε, which arises in the Doppler equation, an approximated formula is derived. A computing program is described which determines for any observer the position of any satellite in dependence from time; it also determines the Doppler frequency with and without atmospheric influence. Assumed is that an element of the orbit of a particular satellite is present and that the model profiles of troposphere and ionosphere can be given. Author

N68-35649# Bonn Univ. (West Germany). Inst. of Physics.
MEASUREMENTS OF DENSITY, COMPOSITION, AND TEMPERATURE OF THE NEUTRAL ATMOSPHERE AT ALTITUDES FROM 110 to 160 km [MESSUNGEN VON DICHTE, ZUSAMMENSETZUNG UND TEMPERATUR DER NEUTRALEN ATMOSPHAERE IM BEREICH VON 110 BIS 160 KM HOEHE]
V. von Zahn Munich Bundesmin. fuer Wiss. Forsch. Aug. 1968 81 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-53) CFSTI: HC $3.00/MF $0.65

On December 12, 1966, at 1320 CST, a Black Brant III rocket carried a monopole spectrometer into the lower thermosphere above Ft. Churchill (59°44'N). In the altitude range between 115 and 155 km the neutral particle density was found to be approximately 1.5 times higher than the average value measured at medium latitudes. A low Ar content indicated an altitude of the turbopause close to 100 km. The ratio of $n(O)/n(O_2)$ was 2.2 at 120 km and 8.2 at 150 km. For the determination of this ratio, assumptions had to be made about loss processes for O due to recombination to O_2 and CO_2 in the ion source. These results are compared with those of other authors and with CIRA 1965. Author

N68-35661# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR OCTOBER 1967 FROM WOOMERA, SOUTH AUSTRALIA
Feb. 1968 27 p
(WRE-CPD-1967/10(W)) CFSTI: HC $3.00/MF $0.65

This bulletin is one of a monthly series containing tabulations of ionspheric data obtained from a station at Woomera, South Australia, located at 30.8° S and 136.3° E. The station at Woomera has been set up for observations associated with upper atmosphere experiments. Observations are likely to continue for some time to come; as the information so obtained is of general interest, it is being reduced to a form suitable for publication. Author

N68-35688# Directorate of Scientific Information Services, Ottawa (Ontario).
RE THE WESTWARD DRIFT OF THE GEOMAGNETIC FIELD

N. K. Osipov and A. N. Fedorov Jul. 1968 6 p refs Transl. into ENGLISH from Geol. i Geofiz. (Novosibirsk), v. 12, 1967 p 97–100
(T-502R)
CFSTI: HC $3.00/MF $0.65

An attempt is made to calculate the drift velocity of the isolines of potential of the main geomagnetic field on the basis of a spherical analysis of the total field and secular variation field. Author

N68-35704# Air Force Cambridge Research Labs., Bedford, Mass.
GEOPHYSICS AND SPACE DATA BULLETIN, VOLUME 8, NO. 1, FIRST QUARTER 1968
Anne L. Carrigan and Norman J. Oliver 1968 277 p
(AD-672978)

AFCRL contract and inhouse data reported from stations throughout the world are tabulated. The following types of data are included: Total field intensity magnetometer; Cosmic ray neutron intensity monitor; Extremely low frequency noise; Riometer; Solar optical patrol observations; Solar radio emission; Vertical incidence ionospheric soundings; Cumulative index for data published in Geophysics and Space Data Bulletin. TAB

N68-35778# Air Force Cambridge Research Labs., Bedford, Mass.
THE RINGING IRREGULARITY IN IONOSPHERIC SCINTILLATION
Frederick F. Slack May 1968 21 p refs *Its* Environ. Res. Papers No. 288
(AFCRL-68-0263; AD-673795)

Strip chart recordings of the 136 MHz signal from the Intelsat Canary Bird Satellite detected at four receiving sites from June 4 to October 17, 1967 were scanned for the occurrence of a regular cyclic type of fading. Sixty-five events were observed and tabulated. Data are presented concerning the direction, speed, and size of these drifting irregularities, the computation of the height, and the diurnal pattern. Author (TAB)

N68-35811# Bonn Univ. (West Germany).
A DETERMINATION OF THE HELIUM AND NITROGEN CONTENT OF THE LOWER THERMOSPHERE (110 TO 155 km) ABOVE FT. CHURCHILL, CANADA [EINE MESSUNG DES HELIUM-UND STICKSTOFFGEHALTS DER UNTEREN THERMOSPHAERE (110 BIS 155 KM HOEHE) UEBER FT. CHURCHILL, KANADA]
G. Hartmann and D. Mueller Aug. 1968 69 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-68-54) CFSTI: HC $3.00/MF $0.65

On December 12, 1966 at 1305 L.T. a quadrupole mass filter, which was specifically designed to determine the helium content of the upper atmosphere, was flown in a Black Brant III rocket from Ft. Churchill, Canada. Besides helium, the number densities of nitrogen and oxygen were obtained in the altitude range of 110 to 155 km. The measured helium content is higher than predicted in CIRA 1965 by a factor of 5. This implies a level for the helium turbopause 10 km lower than assumed in CIRA 1965. This measurement is in agreement with the winter helium bulge theory of the upper atmosphere, deduced from satellite drag data. Author

N68-35822*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE SEASONAL AND DAY TO DAY VARIATIONS IN THE F2 REGION
H. G. Mayr and K. K. Mahajan Jul. 1968 20 p refs Sponsored in part by NRC and AFOSR
(NASA-TM-X-63343; X-621-68-265) CFSTI: HC $3.00/MF $0.65
CSCL 04A

Thomson scatter measurements at Arecibo (18.4°N, 67°W) indicate appreciable seasonal and day-to-day changes in the noontime F-region electron concentration, with a strong positive correlation between the height of the F-layer peak and the peak electron concentration. This correlation is theoretically reproduced by changing, first the neutral particle concentration and later the neutral wind velocity. The changes required in the neutral concentration are much too high to be explained on the basis of the available information on the atmospheric density from the satellite drag data. Horizontal winds directed polewards during winter and equatorialwards during summer, however, can reasonably explain the observed variations and are consistent in terms of the expected seasonal change in the position of the pressure (density) bulge with respect to Arecibo. Author

N68-35824# Ionospharen-Institut Breisach (West Germany).
COMPARISON OF ELECTRON-DENSITY-MEASUREMENTS BY DIFFERENT TECHNIQUES [VERGLEICH VON ELEKTRONENDICHTEMESSUNGEN NACH VERSCHIEDENEN METHODEN]
K. G. Jacobs Aug. 1968 41 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-68-56) CFSTI: HC $3.00/MF $0.65

In a cooperative German–American sounding-rocket project, electron densities have been determined simultaneously by a local and by propagation methods. One of the propagation transmitters caused a strong interference which badly influenced the measuring accuracy of the local experiment. Nevertheless a reasonable agreement of results has been obtained. Author

N68-35873# Air Force Cambridge Research Labs., Bedford Mass.
IONOSPHERIC RESEARCH IN SUPPORT OF ATMOSPHERIC IONIZATION EFFECTS
George J. Gassmann Jun. 1968 59 p refs *Its* AF Surv. in Geophys. no. 5
(AFCRL-68-0318; AD-673794)

For the specific goal to control or predict man-made ionization effects the Defense Department has stimulated research in some areas and particularly in ionospheric physics. The results are reviewed with the implication that most of them are significant only within the larger pool of knowledge being produced by basic research. The review covers recent results gained by means of rockets and satellites on various atmospheric parameters and on the various particle inputs. Further, it reports on conjugate phenomena, on geographical features of particle influx and of electric fields and on progress in radio propagation measuring techniques. Finally, it reviews the observed effects on the ionosphere during the coordinated 12 November 1966 solar eclipse expedition. Author (TAB)

N68-35876# Technical Operations Research, Burlington, Mass.
MEASUREMENTS OF TURBULENCE AND DIFFUSION IN HIGH ALTITUDE CHEMICAL CLOUDS Final Report, 15 Jul. 1966–30 Jun. 1968
C. A. Trowbridge, I. L. Kofsky, and R. H. Johnson Jul. 1968 32 p refs
(Contract AF 19(628)-6128)
(TO-B-68-48; AFCRL-68-0382; AD-673521)

The convective turbulence and diffusion in the upper atmosphere were calculated from radiometrically-calibrated photographs of luminous tracer chemicals released from rockets. Diffusion coefficients were found by the standard method of

measuring the Gaussian width of the glowing cloud. The turbulent flow was characterized by the shape of the logarithmic plot of spectral power density of surface brightness against spatial wave number; this new measurement required the development of a digital computer program for calculating the autocorrelation and spatial frequency spectra from microdensitometrically-sampled photographic radiance data. Results to date are promising in that they correlate well with other measurements of turbulence parameters. Author (TAB)

N68-35934# Aerospace Corp., El Segundo, Calif. Lab. Operations.
OBSERVATIONS OF ENERGETIC ELECTRONS AT SYNCHRONOUS ALTITUDE. VOLUME 1: GENERAL FEATURES AND DIURNAL VARIATIONS
George A. Paulikas, J. Bernard Blake, Stanley C. Freden, and Sam S. Imamoto May 1968 40 p refs
(Contract F04695-67-C-0158)
(TR-0158(3260-20)-9, v. 1; SAMSO-TR-68-286, v. 1; AD-673878)

Energetic electron fluxes above four integral thresholds (E sub e greater than 300 keV, greater than 450 keV, 1.05 MeV, and 1.9 MeV) were measured at synchronous altitude (R = 6.6 R sub e) during the first half of 1967 on board the ATS-1 satellite (1966-110A). The fluxes show a diurnal variation, with the noon-to-midnight ratio being larger for the more energetic electron groups and being larger, on the average, for magnetically disturbed days. Magnetic storms produce a great deal of fine structure in the electron fluxes, with changes occurring on the time scale of minutes; the effect of such storms is to depress the fluxes. Recovery to pre-storm levels is an energy-dependent process which proceeds more slowly for more energetic electrons and apparently in a stepwise manner. Author (TAB)

N68-35938# Ohio State Univ., Columbus. Dept. of Geodetic Science.
A METHOD FOR THE COMBINATION OF SATELLITE AND GRAVIMETRIC DATA
Richard H. Rapp Mar. 1968 79 p refs
(Contract AF 19(628)-5701)
(AFCRL-68-0195; SR-19; Rept.-101; AD-673363)

A set of 2261 5 degrees x 5 degrees mean anomalies was used alone and with satellite determined harmonic coefficients of the Smithsonian Institution to determine the geopotential to various degrees, the highest being n = 14. The results of these solutions were used to form a global 5 degrees x 5 degrees anomaly field referred to the International Gravity Formula. A by-product of this investigation was a value of equatorial gravity of 976.0463 gals in the Potsdam system or 978.0326 gals in an absolute system if -13.7 mgals is taken as the Potsdam correction. Combining this value of gamma sub E with f = 1/298.25, KM = 3.986088 X 10 to the 20th power cm cubed/sec squared, the consistent equatorial radius was found to be 6378141m. Author (TAB)

N68-35973 National Lending Library for Science and Technology, Boston Spa (England).
THE MEASUREMENT OF WIND IN THE BOUNDARY LAYER BY RADAR REFLECTIONS FROM CLEAR SKY
A. G. Gorelik and V. A. Pacaeva [1968] 17 p refs Transl. into ENGLISH from Glav., Uprav., Gidromet. Sluzh., Met. Gidr. (SSSR), no. 8, 1967 p 69–75 In ENGLISH and RUSSIAN
(M-7394) Available from Natl. Lending Library, Boston Spa, Engl.

Correspondance of movements of radar reflections from clear sky with the wind speed and direction obtained by radio-pilot were checked on the basis of repeated wind observations made during the summer of 1966. The Doppler frequency of the reflection signal received from a given height was read directly; and radar measurements were made at angles of elevation not exceeding 15 to 18°. Radio-pilot observations were made by an automatic attachment to the balloon of a large corner reflector with a rate of rise of 1.5 to 2 m/s. The great majority of clear air reflections were found to move with the wind; and the deviation in wind data between radio-pilot and radar could usually be attributed to spatial and time variability of the wind and to errors in radio wind measurement. M.W.R.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-34852 National Lending Library for Science and Technology, Boston Spa (England).
ON THE PROBLEM OF THE SOLAR MAGNETOGRAPH CALIBRATION [K VOPROSU O KALIKROVKE SOLNECHNOGO MAGNETOGRAFA]
I. I. Aleksandrovich, D. A. Kuznetsov, and V. E. Stepanov Sep. 1968 19 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Rezultaty Nablyudenii i Issled. V Period MGSS (USSR), no. 4, 1967 p 122–135
(RTS-4713) Available from Natl. Lending Library, Boston Spa, Engl.: 35s

The methodical problems of calibration and examination of the work of the solar magnetograph are considered. Some methods of the field signal recalculation with simultaneous recording of the magnetic field components at different channels are given. Some errors of the calibrations and measurements are discussed. The methodical problems of calibrations of the work of the SibIZMIR magnetograph are considered. Some methods of the field signal recalculations in the scheme with synchronous recording of the magnetic field conponents at different channels are given. Some errors of the calibrations and measurements are discussed. Author

N68-34896 Northwestern Univ., Evanston, Ill.
SOME VOLTAMMETRIC INSTRUMENTATION STUDIES
Eric Richard Brown (Ph.D. Thesis) 1967 193 p
Available from Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 67-15195

The details of the construction and operation of an electrochemical instrument are given. The construction employs a modular concept using all solid state operational amplifiers. The conventional three-amplifier potentiostat is used as a voltage control device with the added feature of positive feedback of a portion of the current signal to compensate for the ohmic potential losses in the chemical cell as suggested first by Boomen. The reasons for wanting to minimize or eliminate the effects of this ohmic potential loss (iR drop) are discussed. Several signal conditioning devices are also described. Tuned amplifiers are used to amplify only those signals at the frequency of interest. This is most important in second harmonic a.c. polarography where the signal of interest represents only a small percentage of the total signal. A digital data acquisition system is also described. A discussion is presented concerning the stability and accuracy of a three-amplifier potentiostat, using the criteria put forth by Bode. Dissert. Abstr.

N68-34949*# Field Emission Corp., McMinnville, Oreg.
TOTAL ENERGY DISTRIBUTION MEASUREMENTS OF FIELD EMITTED ELECTRONS Progress Report, 14 Feb.–14 May 1968

L. W. Swanson and L. C. Crouser Jun. 1968 36 p refs
(Contract NASw-1516)
(NASA-CR-96878; PR-6) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A new concentric sphere retarding potential energy analyzer tube has been constructed for measuring metals in which solid state band structure measurements have indicated a possibility of field emission total energy distribution (TED) measurements elucidating the band structure information. A preliminary study of the effect of adsorbed layers on TED measurements and total current-voltage relationships has been completed. The TED of field emitted electrons from single crystal faces of cesium and barium coated tungsten and molybdenum surfaces have been measured. The various experimental parameters extracted from TED curves were compared with theoretical values obtained from the Sommerfeld based Fowler–Nordheim theory of field emission by assuming the adsorbate alters the emission through the work function term. Results of adsorption on (111) Mo, (110) Mo, and (110) W are in reasonable agreement with the Fowler–Nordheim theory so far as the TED shapes are concerned. A decrease of the apparent emitting area with adsorbate coverage can be explained by a field polarization effect. However, a sharp increase in the apparent emitting area at low cesium coverages may be due to a resonance tunnelling effect as predicted elsewhere. Author

N68-35060 Case Inst. of Tech., Cleveland, Ohio.
EXPERIMENTAL STUDY OF LOW SPEED MOMENTUM TRANSFER IN PACKED BEDS
Donald Edward Murphy (Ph.D. Thesis) 1967 182 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-16091

A thermistor anemometer, compensated for ambient temperature variation, was developed to measure low fluid velocities. The effect of a damping screen on spatial velocity distributions was investigated. A flow inversion phenomena was for the first time observed in the velocity profiles upstream from the damping screens. A model for predicting the damping effect of screens was derived. Effects of aspect ratio, average velocity, bed height, and inlet velocity profile on packed-bed velocity profiles were also investigated. The velocity profile was independent of both bed height and inlet velocity profile for bed heights greater than ten particle diameters, but was a function of the average velocity. For Reynolds numbers less than two, the velocity profile was independent of the degree of bed consolidation. At higher Reynolds numbers, the profile depended upon the degree of bed consolidation and also exhibited severe localized channeling caused by small inhomogeneities in the bed structure. The average velocity profiles approximated plug flow at all Reynolds numbers, for aspect ratios greater than 90. Dissert. Abstr.

N68-35067*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BIOMEDICAL APPLICATIONS OF SPACECRAFT IMAGE PROCESSING TECHNIQUES Progress Report
20 Mar. 1967 67 p
(Contract NAS7-100)
(NASA-CR-96951) CFSTI: HC $3.00/MF $0.65 CSCL 14E

The established spacecraft image processing techniques are first discussed in some depth. Processed Ranger, Mariner, and Surveyor pictures illustrate techniques such as geometric correction, photometric correction and enhancement, noise removal, and resolution enhancement. The biomedical areas which have been briefly examined to date range from chest X-rays and retinal images to light microscopy image enhancement of chromosomes. Application of an optical tracking device to measure blood flow velocity was studied. Graphic examples of the application of the previously developed image processing techniques to these biomedical areas are presented. Electron microscope resolution is briefly discussed. It is shown that similar computer manipulation of data in the visual frequency domain shows promise of extending the resolution down to atomic dimensions of 1 Angstrom. Author

N68-35105*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
USE OF AN ELECTRONIC VISUALIZATION TECHNIQUE IN THE STUDY OF GAS JOURNAL BEARING BEHAVIOR
Robert Y. Wong, Hugh A. Klassen, Robert C. Evans, and Donald J. Speckman Washington Oct. 1968 18 p Film Supplement Number C-259 to this report is available on loan from NASA, Lewis Res. Center, Cleveland
(NASA-TM-X-1609) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A visualization technique was developed and applied to data obtained during a test of a pivoted-pad gas journal bearing. Clearance probe measurements, recorded on a data tape, were used to show motions of the bearing components relative to each other, on an oscilloscope screen, with bearing motions amplified relative to the journal diameter. Author

N68-35131# Hewlett-Packard Co., Palo Alto, Calif.
TEST INSTRUMENTS FOR MEASUREMENT OF SYSTEM RANDOM NOISE AND IMPULSE NOISE PERFORMANCE
Fritz K. Weinert *In* Calif. Univ. Noise Reduction Conf. [1968] p 147–158 (See N68-35118 22-23)

Two different test methods and test instruments, the HP Model 3722A noise generator and the HP Model 8551B/851B spectrum analyzer, that have gained increasing importance in analyzing system noise are described. The HP 3722A noise generator generates random noise or pseudo-random noise which has all the statistical properties of random noise with the added advantage of repeatability. It delivers constant power output independent of selected bandwidth. The output signal has a flat frequency spectrum from dc to an adjustable upper 3 dB bandwidth of 0.00015 Hz to 50 kHz. The signal is generated by a digital random code generator of variable sequence length and a variable cutoff, digital low-pass filter. The HP 8551B/851B spectrum analyzer makes noise measurements according to military electromagnetic interference standards. Measurements of CW, random, and impulse noise signals can be made over a frequency range from 10 kHz to 40 GHz. Author

N68-35133# California Univ., Livermore. Lawrence Radiation Lab.
SIGNAL TO NOISE RATIO ENHANCEMENT IN NUCLEAR INSTRUMENTATION
Louis W. Ducote *In its* Noise Reduction Conf. [1968] p 169–188 refs (See N68-35118 22-23)

The process of detecting signal in a noise background has been treated in the past primarily by front-end discrimination techniques. Signal isolation with front-end components can be augmented by systems designed to process an obscure signal in a manner which enhances the signal-to-noise ratio. Identification of signal and noise are described, and optimum impedance circuits are reviewed. The signal is broken down into spectral components, while the random noise is derived from equivalent generators. The use of correlation systems to process signals is described and intrinsic problems are evaluated. The elimination of intermodulation products by use of a coherent system is also described. The application of signal processing is applied to transient signal detectors particularly related to pulse-modulated systems. The systems described are compared on an approximate basis limited by the output signal compatibility. Author (NSA)

N68-35134# California Univ., Livermore. Lawrence Radiation Lab.
COMMON MODE VOLTAGE REJECTION IN A LOW-LEVEL DATA ACQUISITION SYSTEM
R. D. Eckard *In its* Noise Reduction Conf. [1968] p 189–204 (See N68-35118 22-23)

One of the basic problems in low-level instrumentation systems is noise. Some of this noise is intrinsic in the associated electronics, but most of it is due to either ground loops or electrical

pick-up through electrostatic or electromagnetic coupling. The effects from these noise sources can never be completely eliminated. However, they can be reduced, and the amount of reduction is dependent on what is required and how much one is willing to pay for this noise reduction. This paper describes different methods of reducing this undesired noise. The common mode rejection ratio of the isolated input amplifier and the balanced input amplifier are discussed in detail. A noise reduction of 3×10^5, 110 dB, in the frequency bandpass dc to 20,000 Hz can be obtained by using an isolated input amplifier plus a driven guard shield around the complete instrumentation package. Author

N68-35138# General Electric Co., San Jose, Calif. Nuclear Electronics Business Section.
NOISE PROBLEMS IN REACTOR INSTRUMENT SYSTEMS
T. Pearson *In* Calif. Univ. Noise Reduction Conf. [1968] p 235-238 (See N68-35118 22-23)

Principal sources of noise are ground loops and switching transients. Radio frequency interference is a problem during construction and nonoperating periods. Different methods of noise reduction must be used for low impedance pulse or mean square voltage systems and for high impedance DC systems. Switching transients have been more of a problem in DC systems than in pulse systems, mostly due to near 1 MHz low frequency dropoff in the latter's amplifiers. Use of multiple shielded cables has proven effective fow low impedance systems while anti-noise treated cables have been effective for high impedance systems. RC network or other arc suppressors across relay or solenoid coils have eliminated their transients. Ground loops have been avoided by sensor isolation. Fortunately, most noise and interference at nuclear power plants is either of relatively low amplitudes or frequencies at instrument and sensor locations. Thus drastic, time-consuming cures have seldom been necessary. A typical plant can operate for several years between nuisance scrams caused by nuclear instruments or associated systems. General Electric nuclear instruments are designed and tested to MIL-I-26600 susceptibility requirements and have needed little on-site modification to reduce noise pickup. Most problems have been solved by noise reduction techniques external to panel-mounted drawers, modules or pages. Author (NSA)

N68-35144*# Raymond Engineering Lab., Inc., Middletown, Conn.
OSO HEAD AND TAPE STUDIES Final Report
Thomas J. Sokira 15 Aug. 1968 34 p
(Contract NAS5-9395)
(NASA-CR-96890; FR-705-8) CFSTI: HC $3.00/MF $0.65 CSCL 14C

Certain types of recording tape were studied relative to the characteristics of the then used magnetic read-write heads. Further efforts were expended in attempting to establish detailed specifications in order to more accurately describe and control key characteristics of procured heads. Basic test plans were written to provide test descriptions. Work performed in studying the tape-head problems resulted in solving the present difficulties so that hardware could be made available. As a result of the study, the head was changed and a different type of recording tape was used. Author

N68-35149*# Research Triangle Inst., Durham, N. C.
AN INVESTIGATION OF THIN FILM OXYGEN PARTIAL PRESSURE SENSORS
T. M. Royal, J. J. Wortman, and L. K. Monteith Washington NASA Sep. 1968 61 p refs
(Contract NAS1-7087)
(NASA-CR-1182) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Design, development, and testing of a laboratory model involving semiconducting zinc oxide and tin oxide films were investigated. Zinc oxide films at elevated temperatures were found to experience resistance changes greater than an order of magnitude when cycled from N_2 to O_2 environments. The zinc oxide films are relatively insensitive to other gases such as N_2, Ar, He, CO_2. A theoretical discussion of the physical mechanisms responsible for the observed phenomena is presented based on oxygen induced changes in the semiconductor donor and acceptor influences. A suitable film substrate, heater, electrical contacting technique, and housing was designed and fabricated into a sensing head. The sensor head was coupled with a control unit for maintaining a constant operating temperature to form the complete sensor. Operating characteristics of the unit were evaluated. Author

N68-35182*# Virginia Univ., Charlottesville. Dept. of Physics.
AN ANNULAR LITHIUM-DRIFTED GERMANIUM DETECTOR FOR STUDYING NUCLEAR REACTION GAMMA-RAYS
A. J. Levy, R. C. Ritter, and K. Ziock Washington NASA Sep. 1968 85 p refs
(Grant NsG-455)
(NASA-CR-1138) CFSTI: HC $3.00/MF $0.65 CSCL 18D

A fabrication technique was developed for truly annular Ge(Li) gamma detectors. Featuring spark-cutting to precisely control the undamaged germanium volume, the detector is capable of standard-geometry techniques such as are used with NaI detectors. Background material relevant to the annular geometry is presented. An extremely explicit, detailed description of the complete fabrication procedure is given, including special cutting, radiant diffusion, and drifting techniques developed here. Measured properties of several detectors are presented, with the emphasis being on the usefulness of the detector high energy gamma ray spectra. Author

N68-35191# Flying Personnel Research Committee, London (England).
A TRACE READER FOR THE DIRECT MEASUREMENT OF GRADIENT AND X AXIS DISTANCE
A. J. Benson (RAF, Farnborough, Engl.) and H. F. Stuart (RAF, Farnborough, Engl.) May 1967 16 p refs
(FPRC/Memo-236) CFSTI: HC $3.00/MF $0.65

A trace reader was developed to aid the analysis of electro-oculographic records. The novel feature of the instrument was the coupling of the cursor arm to a rectilinear potentiometer so that its output was proportional to tan θ, where θ is the angular deviation of the cursor from the X (longitudinal) axis of the record. Another potentiometer coupled to a roller which moved the trace in the X axis, allowed the position of the measured trace on the record to be determined. Error in the assessment of gradient was $\pm$ 0.01 over the range 0 to 3.0, and of X axis distance $\pm$ 1.3 MM IN &&) MM' The voltage outputs of the two potentiometers were easily scaled so that time, in seconds from the datum, and angular velocity of the eye movement, in °/sec, could be read directly from a voltmeter. Author

N68-35230*# General Electric Co., Daytona Beach, Fla. Apollo Systems Dept.
OPERATING AND MAINTENANCE INSTRUCTIONS. DEVELOPMENT MODEL NON-MAGNETIC FLIGHT-TYPE MASS SPECTROMETER
[1968] 69 p
(Contract NAS8-21217)
(NASA-CR-61962) CFSTI: HC $3.00/MF $0.65 CSCL 14B

This manual covers the feasibility model of a ruggedized monopole-type mass spectrometer. The unit may be operated either in a laboratory or in a vibration environment. The design emphasizes ruggedization of the mass spectrometer tube and its associated electronics, employing vibration isolators as needed. Drawings, parts lists, and auxiliary equipment requirements are included in this manual. K.W.

N68-35247# Ballistic Research Labs., Aberdeen Proving Ground, Md.
WIND TUNNEL TESTS OF SOLID STATE STRAIN GAGES
A. S. Platou and H. A. Ricci Jul. 1968 28 p refs
(BRL-MR-1928; AD-673105)

Investigations have been conducted on the use of solid state or semiconductor strain gages to increase the accuracy, range, and/or stiffness of wind-tunnel balances and pressure transducers. One of the main stimulants of this investigation is the need to improve the measuring accuracy of Magnus forces and moments acting on spinning projectiles. Semiconductor strain gages have gage factors 30 to 100 times larger than wire-wound strain gages so that increased sensitivities and accuracies are possible. The principal difficulty with semiconductor strain gages in the past has been the severe temperature effects. It is now possible to temperature compensate these gages so that they respond only to strain. This report will describe the temperature compensation, the calibration, and the use of a Magnus balance for measuring the Magnus moments on a spinning projectile. Author (TAB)

N68-35261# Naval Research Lab., Washington, D. C.
INTENSIFICATION AND REDUCTION OF KODAK NO-SCREEN MEDICAL X-RAY FILM Final Report
Jacqueline Vierling 12 Jul. 1968 11 p refs
(NRL-6732; AD-673238)

Experiments were conducted on Kodak No-Screen Medical X-ray Film to assess the possible methods for the reduction of overexposed film and the intensification of underexposed film. The image density on films given 10 times the normal exposure was successfully reduced by decreasing either or both the time and temperature of development and by using Farmers Reducer (Ansco 310) on the normally developed film. The use of a reducing solution on developed film was judged to be the best approach because the reduction can be controlled accurately and the reduced image suffers no loss of detail. The methods of intensification assessed included increasing the development time and temperature, intensifying the film after development with Kodak Chromium Intensifier (In-4) or Mercury Intensifier (In-1), and fogging the underexposed film prior to development with mercury vapor or with light. Intensification after development produced the best results; the image density above that of the background was increased 42 percent after one treatment with mercury intensifier and 24 percent after one treatment with chromium intensifier. Author (TAB)

N68-35295# Ohio State Univ., Columbus. Dept. of Geodetic Science.
AN EVALUATION OF THE STELLAR-MOON CAMERA SYSTEM Final Technical Report, 24 Aug. 1966–24 Feb. 1968
S. F. Cushman Jun. 1968 50 p refs
(Contract DAAE15-67-C-0010)
(DGS-105; AD-673270)

The results of tests on the Stellar-Moon Camera and associated equipment under field conditions were reported. Major emphasis were placed on determining sources of error by whatever means necessary, and, within limits, making modifications to equipment or methods to overcome these errors. Author (TAB)

N68-35296# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEMICONDUCTOR TRANSDUCERS
N. P. Udalov Nov. 1967 209 p refs Transl. into ENGLISH from Poluprovodnikovye Datchiki (Moscow), 1965 p 1–239
(FTD-MT-24-298-67; AD-673198)

The book contains principles of design elements of automation with non-linear semiconductor resistors whose parameters depend to a substantial extent on temperature. The book considers necessary parameters and temperature characteristics of thermo resistors, diodes, photo diodes, transistors, photo transistors and varistors. It also describes the methodology for an approximate calculation of static and dynamic modes of electric circuits with these instruments. There is established a minimum of parameters, necessary for an exhaustive characteristic of their properties, and there are stated some considerations concerning the methodology of sorting semiconductor instruments with identical characteristics. The book shows the possibility of using the temperature dependence of parameters of the various semiconductor instruments for construction of temperature pickup elements. The book is intended for a wide circle of engineers and technicians interested in problems of automation of industrial processes. Author (TAB)

N68-35298# Ohio Univ., Athens. Dept. of Physics.
ACOUSTIC INTERACTION FOR ARRAYS OF SMALL MAGNETOSTRICTIVE-STACK SONAR TRANSDUCERS AT AN AIR-WATER SURFACE Final Technical Report
F. B. Stumpf, R. T. Richards, and L. A. Crum Jul. 1968 74 p refs
(Contract NONr-4419(01))
(AD-672926)

Experiments and theoretical developments for the acoustic interaction among small 20 kHz magnetostrictive-stack sonar transducers in linear arrays of two and three transducers and planar arrays of three and four at an air-water surface are described. The interaction radiation resistance and reactance due to acoustic loading were studied as functions of number, spacing, relative position and relative phase of the transducers. The effect of a small number of compressed hollow aluminum tubes in controlling the acoustic interaction between the transducers was studied. Other experiments were performed with a low-velocity liquid placed in front of the transducers in order to reduce the interaction. Finally, experiments were conducted with hard (metal) and soft (styrofoam) plane barriers or boundaries in order to control the acoustic interaction between the transducers. The theoretical development for this work was based on the model of interacting dipoles in an infinite medium. It is hoped that the results of this basic study can be used in the design of more efficient sonar arrays using small air-backed transducers at a pc rubber face. Author (TAB)

N68-35322# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRCRAFT INSTRUMENT FOR THE MEASUREMENT OF DIMENSIONS AND CONCENTRATION OF LARGE PARTICLES IN CLOUDS AND PRECIPITATION [SAMOLETNYY PRIBOR DLYA IZMERENIYA RAZMEROV I KONTSENTRATSII KRUPNYKH CHASTITS V OBLAKAKH I OSADAKAKH]
A. N. Nevzorov 30 Oct. 1967 15 p refs Transl. into ENGLISH from Tr. Vses. Nauch. Meteorol. Soveshch. (Leningrad), v. 9, 1963 p 261–268
(FTD-MT-24-246-67; AD-672699)

An instrument for measuring dimensions and concentration of large particles in clouds and precipitation is examined. The instrument, mounted on the side of an aircraft, consists of a transducer, optical circuit, photomultiplier, and recording devices (in the aircraft). The article discusses the principle of operation of the instrument, design of the transducer, calibration and operation of the instrument in flight, and errors in measurements. Author (TAB)

N68-35378# Florida Atlantic Univ., Boca Raton. Dept. of Geography.
A COMPARISON OF MICRODENSITOMETRY AND TV WAVEFORM ANALYSIS AS EXPRESSIONS OF OBSERVED LANDSCAPE PATTERNS ON RADAR
Nelson R. Nunnally Aug. 1968 15 p refs
(Contract Nonr-4761(00))
(TR-6; AD-672561)

Identification of landscape regions with radar is largely dependent upon recognition of variations in texture patterns on the radar image. Since texture is a function of frequency and magnitude of tone changes over discrete distances any objective means of evaluating textures must be based on mechanically measuring and recording tonal information. Comparison of microdensitometer traces with television waveform reveals that, for similar resolution systems, essentially the same tonal information can be obtained from either system. The advantages of lower cost, faster speed and the ability to simultaneously see the location of the scan line being analyzed favor the use of waveform analysis. (TAB)

N68-35387# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A MULTICHANNEL FLOATING HEAD FLEXIBLE MAGNETIC DISK RECORDING SYSTEM [MNOGOKANALNAYA REGISTRIRUYUSHCHAYA SISTEMA NA GIBKIKH MAGNITNYKH DISKAKH S PLAVAYUSHCHIMI GOLOVKAMI]

A. P. Tsitovich 12 Sep. 1967 19 p refs Transl. into ENGLISH from Inst. At. Energii, Dokl. (Moscow), no. 696, 1964 p 1–14
(FTD-HT-67-267; AD-672908)

The disc memory is much simpler to operate than the drum memory and it also eliminates tape storage disadvantages. The flexible disc revolves above a resistive plate which is connected to a motor drive and a valve controlling the air flow. This allows a stabilization of the disc up to several thousand rpm. Magnetic head gaps of 5 to 10 microns were used successfully allowing high density storage of information (5 to 10 impulses per mm). Various diameter discs were studied (usually about 280 mm). Up to 10,000 channels were recorded with one set of heads. Mechanical and electrical diagrams are given for the basic design of the system. Also oscillogram test pulses and a physical picture of the system are shown. The binary logic of the system is described in relating the system to several neutron time of flight spectrometers.
Author (TAB)

N68-35453# Library of Congress, Washington, D. C. Aerospace Technology Div.

SOVIET DEVELOPMENT OF SCIENTIFIC RESEARCH INSTRUMENTS

Jun. 1968 223 p refs
(ATD-68-16-75-1; AD-672796)

Contents: Nuclear devices; Aerodynamic experimental instrumentation; Space data instrumentation; Geophysical instrumentation; Experimental physics; Electronics, and Optical devices. TAB

N68-35516# California Univ., Berkeley. Lawrence Radiation Lab.

DEVELOPMENT OF A HELIUM FILLED STREAMER CHAMBER SYSTEM

Victor Perez-Mendez and Albert W. Stetz 27 May 1968 23 p refs
(Contract W-7405-ENG-48)
(UCRL-16891) CFSTI: HC$3.00/MF$0.65

Development of a helium-filled streamer chamber system is described. Calculations of streamer formation based on two simple models are carried out to determine high voltage pulse requirements. It is found that, with the help of an image intensifier, a Marx generator and resonant charging network can be used to drive chambers of intermediate size. A 1-meter streamer chamber system employing a 350-kV Mark generator is described. This system was used in a recent cyclotron experiment to take 5×10^5 pictures with good resolution and reliability. Author (NSA)

N68-35532# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

IMPROVEMENT IN THE PERFORMANCE OF A BF_3 COUNTER BANK BY MEANS OF A TRANSISTORIZED MIXER CIRCUIT FOR USE IN NEUTRON TIME-OF-FLIGHT MEASUREMENTS [AMELIORATION DES PERFORMANCES D'UN BANC DE COMPTEURS A BF_3 AU MOYEN D'UN CIRCUIT MELANGEUR TRANSISTORISE, POUR UTILISATION DANS DES MESURES PAR TEMPS DE VOL DE NEUTRONS]

G. Frayssé, G. Riccobono, and P. Detourbet 1968 12 p refs In FRENCH; ENGLISH Summary
(EUR-3942.f)

Parallel coupling of BF_3 counters in a bank for time-of-flight measurements presents the two following main inconveniences: the internal capacitances of the counters being added, the pulses get an important attenuation of the signal-to-noise ratio, and the poor amplitude resolution of such an arrangement requires the use of a high discrimination threshold, reducing the detection efficiency. The performances of a single counter can be preserved if each counter is connected with a twin emitter follower for impedance matching. Then, the pulses are mixed in a transistorized circuit with a low impedance output for the connection with the main amplifier at a large distance. Furthermore, an adjustment of the gain of each way allows the compensation of the differences between the multiplication coefficients of every counter. With such a system, there is the advantage, in the case the γ background is high, to utilize independently in each way a discrimination threshold limiting the final pile-up. The performances of this arrangement are presented and compared to those of a single counter.
Author (NSA)

N68-35634*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN INTEGRATING SPHERE SPECTRORADIOMETER FOR SOLAR SIMULATOR MEASUREMENTS

Orlando W. Uguccini Washington Oct. 1968 27 p refs
(NASA-TN-D-4822) CFSTI: HC$3.00/MF$0.65 CSCL 20F

A spectroradiometer, utilizing an integrating sphere and a grating monochromator, and a technique for performing low error spectral measurements of solar simulators are described, together with their evaluation tests. A point by point technique is used in which the spectroradiometer is calibrated with an NBS spectral irradiance standard at each wavelength. Evaluation consisted of checking the calibration of several NBS spectral irradiance standards. Accuracy was also checked by correlating these measurements with measurements obtained with a filter radiometer. Results of the measurements of a carbon arc solar simulator and a xenon arc solar simulator are presented. Author

N68-35838# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugfuehrung.

THE INSTALLATION OF AN OPTICAL STATION FOR THE OBSERVATION OF ARTIFICIAL EARTH SATELLITES [DIE ERRICHTUNG EINER OPTISCHEN STATION ZUR BEOBACHTUNG KUENSTLICHER ERDSATELLITEN]

Wolfgang Ahrens and Karlheinz Hurrass Jun. 1968 67 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-45) CFSTI: HC$3.00/MF$0.65

An optical station for the observation of active and passive satellites was set up 20 miles north of Braunschweig, Germany. The layout of the satation equipped with a Wild BC 4 camera and the observation methods are described. Full details of the properties of the shutter control device and of the time system are given. The methods employed for testing and calibration of the different components of the shutter and of the time system and some test results are reported. The investigations show that the shutter and time system meet the requirements of the Western European Satellite Triangulation since the sum of the systematic and random errors is less than one millisecond. Author

N68-35551# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany). Institut fuer Physik der Atmosphaere.

THE COUNTERFLOW ANEMOMETER, ROTATION ANEMOMETER OF HIGH ZERO-LEVEL SENSITIVITY COMPENSATING THE FRICTION OF REST [DAS GEGENSTROMANEMOMETER, EIN ROTATIONSANEMOMETER HOHER ANSPRECHEMPFINDLICHKEIT MIT KOMPENSATION DER HAFTREIBUNG]

Theodor Dahlem and Dieter Paffrath Jun. 1967 21 p refs In GERMAN; ENGLISH summary

(DLR-FB-67-41; DVL-658) CFSTI: HC$3.00/MF$0.65

The principle of the described anemometer is based on the compensation of the friction of rest by additional drive of the rotor by means of an electromotor. Thus with the permanently rotating rotor the anemometer is able to determine flow velocities ranging between zero and the starting velocity of conventional anemometers. A special measuring method yield considerable sensibility of indication even at point zero of flow velocity, and the increase of zero-level sensitivity is thus of about one order of magnitude. Moreover several measuring devices basing on the described methods are represented. Author

N68-35590*# Conductron Corp., Northridge, Calif. Western Development Center.

THE DEVELOPMENT OF AN ALL PNEUMATIC WIDE ANGLE FREE GYROSCOPE

W. H. Henley Jul. 1968 37 p ref

(Contract NAS1-7570)

(NASA-CR-66675) CFSTI: HC$3.00/MF$0.65 CSCL 17G

Two all-pneumatic free gyroscopes were designed, constructed, and delivered. These gyroscopes incorporated wide angle gas bearing supports, reaction-jet rotor spin motors, wide angle two-axis fluidic pickoffs, and fluidic main and bias torquers. The two delivered units were subjected to a thorough test program to evaluate their performance relative to the following work statement goals: (1) 0.5 to 1.0 degree/hour drift, (2) plus or minus 15 degree operating freedom, (3) erection alignment capability of 2 to 3 arc-minutes, (4) spin-up and alignment time of 5 to 100 minutes, and (5) maximum precession capability of torquer, 30 degrees/minute. Author

N68-35597# Japan Atomic Energy Research Inst., Tokyo. Health Physics and Safety Div.

ONE-DIMENSIONAL DIFFUSION EQUATION CODE PMC FOR CYLINDRICAL NEUTRON DETECTORS WITH A MODERATOR

Hiroshi Ryufuku 6 Apr. 1968 22 p refs In JAPANESE; ENGLISH summary

(JAERI-1163) CFSTI: HC$3.00/MF$0.65

The code PMC can be used to calculate the sensitivities of cylindrical neutron detectors with a moderator. The numbers of energy-groups and regions can be put up to 18 and 5, respectively. Source terms need not be introduced as input data, because they are calculated in the code. Group constants are derived from group-averaged (microscopic) cross sections in one of the subroutines, and therefore, if the latter are prepared on a tape before the use of the code, only a few of parameters may be input to it. If desired, punched cards are obtained as one of the output data, which can be used as an input deck to the S_N-code. Author

N68-35620*# National Aeronautics and Space Administration, Washington, D. C.

NASA CONTRIBUTIONS TO DEVELOPMENT OF SPECIAL-PURPOSE THERMOCOUPLES. A SURVEY

C. Eugene Moeller 1968 97 p refs

(NASA-SP-5050) GPO: HC$1.25; CFSTI: MF$0.65 CSCL 14B

Special-purpose thermocouples, their characteristics, and their application to difficult problems are discussed in relation to innovations and contributions by NASA research programs. Historical development and thermocouple operational principles are reviewed, and mention is made of important symposia and seminars in the thermocouple field. Recent developments in thermoelectric materials for measuring cryogenic temperatures are described, as are thermoelectric materials and electrical insulators used in thermocouples for measurements above 3000°F. Special thermocouple applications for the measurement of gas, surface, and solids temperatures are discussed; as are new thermocouple developments in rocket nozzles, thermal protection systems, and high speed fluid dynamics. Energy-measuring devices that use special thermocouples are described, along with heat flux gauges, a radiant energy calorimeter, and an intrinsic thermocouple device. Developments associated with techniques of attaching thermocouples to test items are discussed, and test circuits to check out many thermocouples at remote locations are included. M.W.R.

N68-35635*# General Electric Co., Daytona Beach, Fla. Apollo Systems Dept.

DEVELOPMENT OF A NON-MAGNETIC FLIGHT TYPE MASS SPECTROMETER Final Report

John Hedman, W. Shannon Little, Larry W. Shaffer, and Waybern L. Wakefield [1968] 166 p refs

(Contract NAS8-21217)

(NASA-CR-61961) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Design, construction, and test data are presented on a small ruggedized flight feasibility model of a mass spectrometer, based on the monopole principle and intended for ultimate use in Saturn space vehicles. The equipment is described in detail, the operating principles are given, the tests conducted are discussed, applications are considered, and recommendations for future activities are made. Author

N68-35650# Teldix Luftfahrt-Ausruestungs G.M.B.H., Heidelberg (West Germany).

DEVELOPMENT OF A RECOVERABLE SOUNDING ROCKET WITH PARAGLIDER. DESIGN OF A TRANSDUCER SYSTEM FOR DEVELOPMENT PHASE 3/4 [ENTWICKLUNG EINER GEZIELT RUECKFUEHRBAREN HOEHENFORCHUNGSRAKETE MIT PARAGLEITER: ENTWURF EINER MESSGEBERANLAGE FUER DIE ENTWICKLUNGSPHASE 3/4]

W. Tettenborn Bad Godesberg Bundesministerium fuer wiss. Forsch. Jun. 1968 68 p refs In GERMAN; ENGLISH summary

(BMwF-FB-W-68-42) CFSTI: HC$3.00/MF$0.65

This study contains the design efforts for the development of a transducer system for measuring accelerations, angular velocities, air speed, vibration, temperatures, and mechanical stress in the sounding rocket, project 621. Several methods for attitude measuring are described. Problems that occurred during the setup of the measuring program and the selection of the sensors are discussed. The report concludes with a summary of the sensors proposed for use in the sounding rocket. Author

N68-35654# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorenwicklung.

USE OF THE HE-3 SEMICONDUCTOR NEUTRONSPECTROMETER-SANDWICH FOR MEASURING THE SPECTRA IN THE VARIOUS NEUTRON SOURCES USED IN REACTOR TECHNOLOGY [ANWENDUNG DES HE-3-SANDWICH-HALBLEITER-NEUTRONENSPEKTROMETERS ZUR MESSUNG DER SPEKTRAN VERSCHIEDENER IN DER REAKTORTECHNIK GEBRAEUCHLICHER NEUTRONENQUELLEN]

P. Cloth and R. Hecker Apr. 1968 48 p refs In GERMAN

(JUL-522-RG) CFSTI: HC$3.00/MF$0.65

A helium semiconducting spectrometer with sandwich diode detector, was used to measure the spectrum of an

americium-beryllium source above energies of 5 to 6 MeV. Up to 11 MeV very good fast neutron spectra were obtained; however, high gamma flux rates below the silicon interference reaction restricted spectral studies on americium-beryllium sources to above 2, 5 MeV and on californium^{252} fission neutrons to above 2 Transl. by G.G.

N68-35677# California Univ., Livermore. Lawrence Radiation Lab. Electronic Engineering Dept.

Ge(Li) GAMMA-RAY SPECTROMETERS OF HIGH SENSITIVITY AND RESOLUTION FOR BIOLOGICAL AND ENVIRONMENTAL COUNTING

Paul. L. Phelps, Keith O. Hamby, Bernard Shore, and Gilbert D. Potter 24 May 1968 39 p refs

(UCRL-50437) CFSTI: HC$3.00/MF$0.65

A high resolution, anticoincidence shielded, gamma ray spectrometer was developed to analyze complex, low level mixtures of gamma emitting radionuclides in environmental and biological samples. The detector is a planar, lithium drifted, germanium diode in combination with a sodium iodide crystal both of which are contained within a plastic annulus. Two detectors were evaluated: one of a large surface area, and one of a smaller area. The sensitivity permits the detection of several radionuclides in environmental samples at levels below 0.05 pCi/g or 0.05 counts/min; e.g., 10 pCi of ^{137}Cs can be easily detected in 2 liters of cows milk. The spectrometer resolution of the 18 cm^3 Ge(Li) detector for a gamma energy of 1.17 MeV is 2.9 keV, full width, half maximum. Examples are presented of the spectral analysis of radionuclides in various biological and environmental samples contaminated with worldwide fallout, with debris from nuclear cratering experiments, or with reactor effluent. Author (NSA)

N68-35706# RMS Regelungs- und Messtechnik Dipl.-Ing. Schmidt KG, Reinbek /Hamburg (West Germany).

DISSERTATION ABOUT THE REQUIREMENTS ON SIDERIAL TURNTABLES AS TEST EQUIPMENT FOR GYROSCOPES AND POSITION REFERENCE SYSTEMS [UNTERSUCHUNGEN UEBER DIE ANFORDERUNGEN AN SIDERISCHE DREHTISCHE ALS PRUEFGERAETE FUER KREISEL- UND LAGERE]

R. Steller Munich Bundesmin. fuer wiss. Forsch. Jul. 1968 38 p refs In GERMAN; ENGLISH summary

(BMwF-FB-W-68-47) CFSTI: HC$3.00/MF$0.65

The state-of-the-art and future requirements for the use of sidereal turntables as test equipment for gyroscopes are discussed. Gyros with one and two degrees of freedom, stabilized platforms, and gyro angular accelerometers are considered. The development of the sidereal turntable is described, including improvements in mechanical and electrical accuracy of components. The technical stand of torque motor development and methods of angular readout are evaluated. It is shown that the electro-optical system promises greatest resolution and accuracy at lowest expenditures. Strap-down systems and test requirements are also considered. Transl. by K.W.

N68-35709# Bonn Univ. (West Germany).

DIGITAL PROCESSING OF ROCKET-SPECTROMETER MEASUREMENTS [DIGITALE VERARBEITUNG DER MESSWERTE VON RAKETEN-SPEKTROMETERN]

K. Mauersberger Bad Godesberg Bundesministerium fuer Wiss. Forsch. Jun. 1968 54 p refs In GERMAN; ENGLISH summary

(BMwF-FB-W-68-43) CFSTI: HC$3.00/MF$0.65

Mass spectrometers for measuring absolute number densities in the upper atmosphere have to be calibrated extensively before flight. During laboratory calibrations and flight, about 10,000 mass peaks must be recorded for each instrument. A data system is described which digitizes up to 9 analog channels with a fixed rate of 10,000 A/D conversions per second. This information is recorded on magnetic tape in a gapless, but otherwise IBM-compatible format. Examples are given of computer analyzed spectra taken in the laboratory and during rocket flight. Author

N68-35757*# Minnesota Univ., Minneapolis. Aeronautics and Engineering Mechanics Dept.

WIND TUNNEL CALIBRATION OF THE "ARCASONDE 1-A" AT SIMULATED ALTITUDES BETWEEN 35 AND 57 KM

E. L. Haak and R. A. Noreen Washington NASA May 1968 40 p refs

(Contract NAS1-7477)

(NASA-CR-66638) CFSTI: HC$3.00/MF$0.65 CSCL 09F

Results of tests conducted with a full-size Arcasonde 1-A atmospheric temperature sensing unit in a low density subsonic wind tunnel are presented. The unit consisted of a 0.25 mm (0.010 in.) thermistor bead mounted on a standard Arcasonde instrument package. Equilibrium temperatures of the thermistor bead were measured for Mach numbers from 0.1 to 0.3, and Knudsen numbers from 0.04 to 0.8 in an airstream total temperature with angle of attack and response time to a step change in temperature were also measured at the same flow conditions. Author

N68-35760# Goodyear Atomic Corp., Piketon, Ohio.

PORTABLE U-235/U-238 ISOTOPIC MASS SPECTROMETER FOR PROCESS CONTROL

P. I. Davis and J. Lang 1 Apr. 1968 16 p refs

(Contract AT(33-2)-1)

(GAT-571) CFSTI: HC$3.00/MF$0.65

A portable, automatically-operated mass spectrometer has been designed and evaluated for providing onstream ^{235}U analyses for control of a UF_6 withdrawal stream; on-line relative precision of 0.039 percent in the range of 2 percent by weight of ^{235}U has been achieved. Analysis of an unknown sample requires 12 minutes, and instrument scalers for two standards and for the unknown sample are digitally displayed for subsequent computation of assay by an interpolative method. Reduced gas sample flow extends the service life of the electron-bombardment ion sources so that the sources are capable of over 2500 determinations. The analyzer is a stainless-steel tube differentially pumped with sputter-ion high-vacuum pumps. Mobility for use throughout cascade areas is provided by a four-wheel, temperature-and-humidity-controlled environmental trailer weighing 7000 pounds. Author (NSA)

N68-35842# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

GRAZING INCIDENCE VACUUM ULTRAVIOLET MONOCHROMATOR WITH FIXED EXIT SLIT FOR USE WITH DISTANT SOURCES

C. Kunz, R. Haensel, and B. Sonntag Apr. 1968 7 p ref

(DESY-68/21)

An ultraviolet spectrograph mounting, designed to overcome the normally encountered disadvantages of the overlapping of higher orders and the continuous change of the exit or entrance path of light, is described. The monochromator is composed of a system of rotating spherical or paraboloidal mirrors and grating. Author

N68-35881# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.

KINETHEODOLITE FILM REDUCTION PROCEDURE

Bennet McInnes 12 Oct. 1968 14 p

(ROE-STS-57) CFSTI: HC$3.00/MF$0.65

An outline of a procedure is given in which it is necessary to reduce film and tape records to a list of timed positions for the satellite by applying instrumental corrections and smoothing out tracking errors. ESRO

N68-35885# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
SOME PROBLEMS OF CONSTRUCTING A HIGH RESOLUTION SPECTROMETER WITH HIGH COUNTING RATE [NEKOTORYE VOPROSY POSTROENIYA SPEKTROMETRA PRI POVYSHENNYKH TREBOVANIYAKH K RAZRESHENIYU I ZAGRUZKE]
B. Yu. Semenov and V. A. Antyukhov 1968 17 p refs In RUSSIAN Presented at the Intern. Symp. on Nucl. Electron., Versailles, France, 1968
(JINR-P13-3813)

The dependence of the measurement error upon T/r (the filter time constant vs input pulse rise time) with the latter's fluctuations for the amplifier with a high resolution spectrometer with RC-filters (ordinary and with correction) with various approximations of the input signal (exponential, parabolic, linear) is studied. Analytical expressions and diagrams are given which are convenient for practical use. A method is suggested for estimating the effect of the transfer functions of amplifying cascades and the analog-digital converter for the measurement error. Author (NSA)

N68-35886# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
CALCULATION OF THE SPECTROMETER ERROR DUE TO THE . FLUCTUATION OF THE INPUT SIGNAL FRONT [RASCHET POGRESHNOSTI SPEKTROMETRA, SVYAZANNOI S FLYUKTUATSIEI FRONTA VKHODNOGO SIGNALA]
B. Yu. Semenov and V. A. Antyukhov 1968 19 p refs In RUSSIAN Presented at the Intern. Symp. on Nucl. Electron., Versailles, France, 1968
(JINR-P13-3812)

The minimum limit interval of pulse sequence is considered. Simple formulas with good approximation are obtained for the determination of this interval for the amplifier of the high resolution spectrometer with RC-filters (ordinary and with correction) with various ways of coupling between the amplifier and transformer (direct coupling, through a baseline restorer and through an RC-circuit) with the given measurement error due to tail pile up. The aim of the work is to find the optimal solution in concrete cases of designing, i.e., to choose the most simple system at given requirements to the accuracy and counting rate. Author (NSA)

N68-35925# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
COMPARISON OF GAMMA RAY IMAGING DEVICES WITH A NEW THREE DIMENSIONAL PHANTOM
Michael Hayes 10 Jun. 1968 9 p refs
(Contract AT(04-1)-GEN-12)
(SM-108/117) CFSTI: HC$3.00/MF$0.65

A 3-dimensional phantom for providing information on imaging capacity for clinical use is described. It consists of either solid rods or hollow tubes of different diameters positioned diagonally in a plastic tank. With this phantom, imaging capacity can be determined for all depths from 0 to 7 in. by a single scan examination. Scans of the phantom using various radioisotope scanners are included. NSA

N68-35936# Chicago Aerial Industries, Inc., Barrington, Ill.
CAMERA SET, STILL PICTURE, KS-71 Final Report, 1 Jun. 1963–31 Dec. 1967
O. J. Smith Jun. 1968 40 p refs
(Contract DA-36-039-AMC-03192(E))
(CAI-6720-F; ECOM-03192-F; AD-673853)

The KS-71( ) camera set provides automatic photographic capability and achieves high resolution levels with each of six different interchangeable lens cones. For day reconnaissance, focal lengths of .92, 1-1/2,3.6, and 12 inches are provided. A 4-inch, f/1.4 lens is used for night reconnaissance in conjunction with pyrotechnic or electronic flash illumination. The frame camera has the capacity for 250 feet of standard base 70-mm film. It features a maximum autocycle rate of 10 frames/second, a focal plane shutter, 1/4000 to 1/100 sec exposure time, automatic exposure control of shutter speed and lens aperture, data recording using a CRT, and either magazine or cassette film loading. The V/H detector (LA-246) optically senses the vehicle V/H and automatically controls camera cycle rate and IMC rate. It is comprised of a scanner and a converter. The scanner operates in the IR spectrum to allow both day and night operation. It is also vertically stabilized to minimize errors due to aircraft motions. The converter features digital computation of camera control signals and yields highly accurate IMC. A three-axis stabilized-camera mount (the LM-120)) maintains camera verticality and steadiness independent of aircraft perturbations. Cockpit control panels are provided for use in manned aircraft. Cabling to inter-connect system components is also provided. A test set permits ground checkout of equipment Carrying cases are provided for all components. Author (TAB)

N68-35940# Radio Corp. of America, Princeton, N. J.
CONTINUOUS-TONE ELECTROPHOTOGRAPHY Final Report, 4 Jan.–22 Sep. 1967
Henderson C. Gillespie, Wendell M. Lee, and Gerald Lozier Aug. 1968 51 p refs
(Contract DAAK02-67-C-0176)
(AD-673881)

Two approaches to the experimental investigation of the electric fields near a charged and imaged zinc oxide/binder layer were made, to elucidate the role of electrostatic induction of the field near a discontinuity between charged and discharged areas: (1) Steps to construct a 0.001-in. -diam. probe for exploring the electric field near a charged zinc oxide/binder layer were developed; and (2) micrographs of a layer charged uniformly and then discharged in a bar pattern by light have been made in a scanning electron microscope. Analysis of the micrographs indicates the results to be a function of the field near the surface, but this has not been confirmed. Basic mechanisms and forces occurring in liquid development of Electrofax were investigated, and a literature search was performed. Two mechanisms for charging particles are discussed: acid-base equilibrium and specific adsorption. The principal transport process for bringing particles to the deposition site is by electrophoretic focus. A dielectrophoretic transport mechanism can be a factor in divergent fields. The two principal forces holding particles on the Electrofax paper are electrostatic and/or van der Waals. The point in the deposition at which charge neutralization takes place, to date, has not been determined. The role of particle size on time deposition and the key factors in continuous-tone development are discussed. Author (TAB)

N68-35952# California Univ., Berkeley. Lawrence Radiation Lab.
A PHOTOMULTIPLIER SHIELD AND BASE SYSTEM
Sherwood Parker, William Oliver, and Charles Rey 11 Jan. 1968 8 p ref
(Contract W-7405-eng-48)
(UCRL-18031) CFSTI: HC$3.00/MF$0.65

A photomultiplier shield and base system are described with simple construction, complete electrical shielding suitable for use near large spark chambers, quick access, and magnetic shield length optimized for axial fields. NSA

N68-35968# Environmental Science Services Administration, Atlantic City, N. J. Test and Evaluation Lab.
DEVELOPMENT OF TRANSMISSOMETER CALIBRATION TECHNIQUES AND DEVICES, PHASE 1 INTERIM REPORT
Frederick C. Hochreiter Feb. 1968 61 p refs Sponsored by FAA
(RD-68-7; AD-673263)

Two side-by-side 250-ft. baseline transmissometers are used to isolate calibration techniques that may be useful under all

visibility conditions. Current calibration procedures are limited to application in visibilities of 5 miles or more. A review of these procedures is presented. Testing anticipates extending some calibration techniques to visibilities less than 5 miles. Preventive maintenance procedures are discussed which may be utilized to minimize transmissometer outages. Inspection of Weather Bureau Electronic and Maintenance Summaries shows that timely replacement of the projector lamps will reduce lamp failures to near zero. Interim results of testing show that the practice of aging CE-75 phototubes should not be overlooked. The Appendix presents detailed transmissometer alignment and calibration procedures reflecting current techniques. Author (TAB)

N68-35974 Joint Publications Research Service, Washington, D. C.

NEW HIGH-PRECISION OPTICAL THEODOLITE T1

D. A. Anikst 19 Sep. 1968 4 p ref Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 6, Jun. 1968 p 24–29 (JPRS-46457) CFSTI: $3.00

An optical theodolite, designated T1, is described that weighs 11 lb and has an 0".1 accuracy of reading based on scales of the readout microscope and the ocular micrometer. Magnification of the readout system is 36X for the horizontal circle and 54X for the vertical circle. The T1 was designed for making angular measurements at the triangulation points of the second class and for polygonometry use. It can also be used for first class triangulation and, in conjunction with special equipment, for astronomical fixes of the third and fourth class at any latitude. Specifications for five theodolites are tabulated that give their accuracies to the nearest second; these optical instruments include the T1 and four others developed in 1925, 1939, 1945, and 1950. M.W.R.

N68-35975# Joint Publications Research Service, Washington, D. C.

QUANTUM MAGNETOMETRY

N. M. Pomerantsev, V. M. Ryzhkov, and G. V. Skrotskiy 18 Sep. 1968 97 p refs Transl. into ENGLISH from Geofiz. App. (Leningrad), no. 33, 1967 p 13–94 (JPRS-46444)

A discussion on the principles of the physical phenomena of nuclear magnetometry considers the free precession of nuclear moments in a constant magnetic field, the effect of inhomogeneity of the magnetic field in free precession damping, and forced precession of nuclear moments. The reaction of an oscillatory circuit to nuclear precession is discussed, as are methods of establishing free precession and their characteristics. The latter includes the E. Hahn, method, the Overhauser effect, optical pumping of atoms, and nuclear spin generators. Attention is also given to generators that compensate for the radio frequency field, sideband generators, and spin generators with dynamic liquid or optical pumping. Design of nuclear magnetometers is considered in general terms, and the development of such devices in the USSR and other countries is detailed. Both ground and space magnetometers are considered. M.W.R.

N68-35991# California Univ., Livermore. Lawrence Radiation Lab.

A TELESCOPE FOR EXAMINING THE VERTICAL INTENSITY OF COSMIC RAY FLUXES ON A WORLD-WIDE BASIS

G. A. MacGregor and R. G. D'Arcy 8 Apr. 1968 15 p (Contract W-7405-eng-48) (UCID-15324) CFSTI: HC $3.00/MF $0.65

The mechanical and electrical features of a fluorescer-photo-multiplier cosmic ray telescope are described. The telescope has been used on frequent occasions to obtain cosmic ray equator points and to examine the vertical cosmic ray intensity at atmospheric depths of 200 to 250 g/cm^2. Statistical errors in the total counting rates were less than 1% and overall experimental errors totaled less than 2%. Author (NSA)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-34844 Rensselaer Polytechnic Inst., Troy, N. Y.

SLIDING OF COPPER-BASED SINTERED MATERIAL

Eugene Felix Finkin (Ph.D. Thesis) 1967 109 p Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-12836

The study showed that the coefficient of friction, at constant load, can follow four distinct constant values with increasing temperature, with rapid transitions between these values. The causation of this phenomenon is most likely chemical. The temperatures at which transitions occur are dependent on prior oil use. The surface films concerned are untenacious. The coefficient of friction is related to load by a power law. An analytical study of disc packs gave the load variation through a disc pack due to spline friction. Functional dependence between coefficient of friction and sliding speed can be accounted for. The synthesis of the experimental and analytical studies predicts the possible occurence of an apparent drop of 20% to 30% in the coefficient of friction in a clutch pack. Dissert. Abstr.

N68-35225*# Techtran Corp., Glen Burnie, Md.

MECHANICAL PROPERTIES OF HIGH STRENGTH MATERIALS WITH COATINGS PRODUCED BY THE PLASMA SPRAY-COATING METHOD [MEKHANICHESKIYE SVOYSTVA VYSOKOPROCHNYKH MATERIALOV S POKRYTIYAMI, POLUCHENNYMI METODOM PLAZMENNOGO NAPYLENIYA]

V. A. Gladkovskiy and M. L. Zinshteyn Washington NASA Sep. 1968 6 p refs Transl. into ENGLISH from Termoprochnost' Materialov i Konstrutivnykh Elementov (SSSR), 1967 p 119–122 (Contract NASw-1695) (NASA-TT-F-11927) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A study was made of the effects of coating high-strength materials using the plasma spray method. Tests were made on aluminum oxide and tungsten coatings, and the results are compared. First a primer layer of chrome–nickel steel was applied, then a plasma spray-coating was added and polished to a desired thickness. Tests were then carried out for breaking strength, bending strength and adhesive strength; polished sections were prepared for the purpose of studying the microstructure. The results of both aluminum oxide and tungsten plasma coatings were compared; in general, it was found that the finer the grains of powder used the better the results. It was determined that the endurance limit, fatigue strength and durability after coating were higher than for the uncoated base metal. It was found that coating causes less wear, affords protection against corrosion, provides good thermal insulation, and also has good electrical insulation properties. Author

N68-35257 National Lending Library for Science and Technology, Boston Spa (England).

PLASTIC METAL FLOW DURING SIMULTANEOUS EXTRUSION IN TWO DIRECTIONS [PLASTICHESKOE TECHENIE METALLA PRI DVYKHSTORENNEI ZAKRITOI PROSHIVKE]

L. G. Stepanskii Sep. 1968 11 p refs Transl. into ENGLISH from Kuznechno Shtampovechnoe Proizv. (USSR), no. 3, 1964 p 8–11
(RTS-4751) Available from Natl. Lending Library, Boston Spa, Engl.: 10s

The use of two-way extrusion in the manufacturing of can-shaped components is complicated by the fact that their final geometry is not determined by the volume of metal displaced, but requires a large number of experiments. An approximate energy calculation was developed to reduce the number of such experiments, with the following assumptions made: (1) The billet material is homogeneous and not hardened, and its plastic deformation is axisymmetric. (2) A plane of separation exists during extrusion that divides the metal flow into upper and lower streams. (3) Friction forces at the contact surfaces between the billet and tool are constant in magnitude. An upper estimate of the stress required in two-way extrusion is determined; and equations are given for finding the average extrusion pressure. Attention is also given to the case of one-way extrusion, with the appropriate equations included. M.W.R.

N68-35258 National Lending Library for Science and Technology, Boston Spa (England).
SPRAYING OF LIQUIDS THROUGH ROTATING POROUS SOLIDS
W. Gösele 17 Jul. 1968 16 p refs Transl. into ENGLISH from Chem. Ing. Tech. (Berlin), v. 40, 1968 p 37–43
(M-7387) Available from Natl. Lending Library, Boston Spa, Engl.

A quantitative assessment was made of the size of the droplets formed, and the design and operating of the spraying devices used to spray liquids through rotating porous solids were investigated. Droplets having a very narrow range of diameters were obtained using porous rotating cylinders, and similarity approximations were used for determining droplet size and throughput. Model flow equations are presented, the atomization of wetting liquids is discussed, and some experiments of spraying with wetting as well as with non-wetting liquids are reported. The kinds of drop formation observed are indicated, and some practical applications from droplet spraying are mentioned. M.W.R.

N68-35265# California Univ., Los Angeles. Western Management Science Inst.
A RESEARCH METHODOLOGY FOR STUDYING COMPLEX SERVICE SYSTEMS
Rosser T. Nelson Jul. 1968 29 p refs
(Contract Nonr-223(73))
(WMSI Working Paper-139; AD-673233)

The paper describes a research methodology for studying problems of analysis, design, and control in complex service systems. The proposed methodology is based upon the total systems point of view in the sense that the physical and decision-making aspects of the service system are considered and are related to environmental factors. The methodology was developed with two research areas in mind: (1) abstract studies of models of complex service systems and (2) field studies of complex service systems. An example is included to illustrate the first type of application. Field studies may be expected to present far more of a challenge because of the identification, modeling, and data requirements which will arise in actual situations. The methodological plan presented here focuses attention on these requirements as an integral part of systems analysis. Author (TAB)

N68-35279# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW TECHNOLOGICAL PROCESSES IN THE PRESSURE TREATMENT OF METALS [O RASPREDELENII SKOROSTEY DVIZHENIYA METALLA, DEFORMATSIY I NAPRYAZHENIY PO SECHENIYU ZAGOTOVKI PRI PROKATKE ALYUMINIYEVYKH SPAVOV]
A. I. Kolpashnikov 30 Jun. 1967 189 p refs Transl. into ENGLISH from Tr. Inst. Mosk. Aviats. Tekhnol. Inst. (Moscow), no. 57, 1963
(FTD-HT-66-357; AD-673197)

Contents: On the distribution of metallic mobility rates, deformation and stresses along a billet cross-section in rolling of aluminum alloys; On the problem of anoxidative heating of billets in a protective atmosphere with lithium vapors; Preparation of bi-metallic rods and wires from aluminum alloys; On the possibility of utilizing sodium stearate and its substitutes as technological lubricants in the extrusion of light alloys; Die casting of thin-walled parts from molten metal; Development of production technology and investigation of the physico-mechanical properties of thin sheets of magnesium alloys; Investigation of bonding conditions during the joint plastic deformation of alloys of the duralumin type with alloys of the system Al-Mg; Improvement of contact spot welding of D16 alloy sheets by cladding with AMg alloy; Electron-microscope method of investigating SAP using carbon replicas; Cladding SAP; Methods of increasing the wieght of blanks for rolling SAP sheet; Strength of clad SAP sheet; Comparative evaluation of the weldability of clad and nonclad SAP by resistance welding methods; Technology for spot and roller welding of clad SAP; Structural changes during heating of SAP; and On the problem of the character of the distribution of the oxide phase in SAP. TAB

N68-35291# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RESISTANCE WELDING OF THIN-WALLED ALUMINUM STRUCTURES [OSOBENNOSTI VYPOLNENIYA SVARNO-KLEYEVYKH SOYEDINENIY IZ ALYUMINIYEVYKH SPLAVOV]
B. B. Rubanovich 6 Dec. 1967 22 p refs Transl. into ENGLISH from Kontakt. Svarka Tonkostennykh Alyumin. Konstrukt. (Moscow), 1966 p 90–92, 136–139
(FTD-MT-24-325-67; AD-672707)

The article describes and expounds upon the distinctive features of producing glued-welded joints from aluminum alloys. It compares these with features of other joints. Author (TAB)

N68-35310 National Lending Library for Science and Technology, Boston Spa (England).
CONCERNING THE MEASURING UNCERTAINTIES IN THE DETERMINATION OF INDEXING ERRORS OF GEAR WHEELS [ZUR MESSUNSICHERHEIT BEI DER ERMITTLUNG DER TEILUNGSFEHLER VON ZAHNRAEDERN]
Ing. R. Noch and O. Steiner 19 Aug. 1968 18 p refs Transl. into ENGLISH from Werkstattstechnik (Berlin), v. 55, no. 2, 1965 p 74–79 In ENGLISH and GERMAN
(MEL-TT-1966) Available from Natl. Lending Library, Boston Spa, Engl.

Summation indexing errors were not reliably obtained from individual indexing errors in the case of gear wheels with a large number of teeth. Uncertainties in measuring summation indexing errors were considered, as were measurement errors resulting from the eccentric position of the teeth, errors following temperature changes, and errors from zero point displacement of the measuring equipment. M.W.R.

N68-35374# Coating and Chemical Lab., Aberdeen Proving Ground, Md.
RAPID METHOD FOR DETERMINING QUALITY OF STANNATE IMMERSION COATINGS Final Report
William H. Deaver and Howard S. Brady Jul. 1968 22 p refs
(CCL-252; AD-673112)

The report covers the development of a rapid means for determining the quality of a deposited stannate immersion coating.

An apparatus was designed to measure the quantity of hydrogen gas evolved when a magnesium-steel couple is placed in an electrolyte. It was shown that this method could be used as a rapid means for evaluating the quality of stannate immersion coatings.
Author (TAB)

N68-35435# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MECHANIZING THE PROCESS OF MANUFACTURING GLUEWELDED CONNECTIONS [MEKHANIZATSIYA PROTSESSA IZGOTOVLENIYA KLEYESVARNYKH SOYEDINENIY]
V. N. Shavyrin 13 Oct. 1967 13 p Transl. into ENGLISH from Akad. Nauk SSSR, Komis. Po Tekhnol. Mashinostr. Gosnii Mashinoved., Avtomatiz. Protsessov Svarki i Obrabotki Davleniyem (Moscow), 1966 p 99–105
(FTD-MT-24-252-67; AD-672701)

A technological process has been developed for making joints by a combination of resistance spot welding and cementing of metal structural elements. The addition of special structural glue to the joint increases the strength characteristics and provides anticorrosion protection. The author describes the universal VUS-1 welding manipulator designed for mechanization of the spot welding process on large structures with compound curvature. An eight-channel programmed control unit for this manipulator is also described. Closed-circuit TV may be used for remote control. The operation of the BPU-1 programmed regulator for automatically welding elements of varying thickness is discussed. Mechanization of the electrode cleaning process is considered and it is pointed out that the GZP dressing unit based on the UD-2M angle drill may be used for solving this problem. Finally, an automatic machine for applying the cement to the welded joint (capillary method) is described.
Author (TAB)

N68-35456 National Lending Library for Science and Technology, Boston Spa (England).
ACCOUNTING FOR THE VARIABLE OIL VISCOSITY IN THE CALCULATION OF PLAIN BEARINGS [BERUECKSICHTIGUNG DER VERAENDERLICHEN OELVISKOSITAET BEI DER BERECHNUNG VON GLEITLAGERN]
E. Pollmann 27 Aug. 1968 27 p refs Transl. into ENGLISH from Konstruktion (West Berlin), v. 19, no. 5, 1967 p 176–183 In ENGLISH and GERMAN
(NEL-TT-1991; T-5998) Available from Natl. Lending Library, Boston Spa, Engl.

A new method is described for calculating bearing temperatures, taking the variable viscosity into account. The method is based on the simultaneous solution of the two differential equations for the development of pressure and temperature in the oil gap. With slight transformations, it can be applied to radial and axial thrust plain bearings. The results of calculations of partial bearings with enclosed angles of 120° and 150° are given in the form of curves. Results are also given for an axial thrust bearing with the width ratio B/L = 1. The application of the results plotted in the form of curves is shown by two examples of calculations.
Author

N68-35540# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HOT EXTRUSION OF PIPES FROM HARD TO FORM STEELS [GORYACHEYE PRESSOVANIYE TRUB IZ TRUDNODEFORMIRUYEMYKH STALEY]
P. K. Teterin, L. Ye. Al'shevskiy, and L. M. Kurochkina 3 Nov. 1967 13 p Transl. into ENGLISH from Tekhn. Progress V Trubnom Proizv., Met. (USSR), 1965 p 256–262
(FTD-MT-24-297-67; AD-672913)

The process of hot extrusion of tubing from hard-to-form steels was investigated. Mechanical properties of extruded and cold-rolled tubing are presented.
TAB

N68-35596# Joint Publications Research Service, Washington, D. C.
RESISTANCE OF WELDED JOINTS AGAINST THE FORMATION OF COLD CRACKING
R. A. Kozlov 24 Sep. 1968 12 p refs Transl. into ENGLISH from Svarochn. Proizv. (USSR), no. 7, Jul. 1968 p 1–3
(JPRS-46511)

The problem of cold cracking in the weld metal and in the heat affected zone is very complex and diversified. Different hypotheses attempt to explain the mechanism of its formation and varying criteria for evaluating the tendency of welded joints to cold cracking have been proposed. Cold cracking in the weakness zone is associated with the delayed fracture phenomenon. The basis of the delayed fracture theory is the hypothesis propounded by S. S. Shurakov according to which a decrease in the strength of a freshly chilled steel is related to the processes of a quasiviscous and plastic flow along the grain boundaries. In conformity with this, the minimum strength in the weakness zone following welding was taken as the criterion for a quantitative estimate of the resistance of the weakness zone to cold cracking. This criterion agrees with the data for the welding of chilled high carbon steels.
Author

N68-35603*# Techtran Corp., Glen Burnie, Md.
ACHIEVEMENTS IN THE FIELD OF SPACE MATERIALS SCIENCE AND THEIR USAGE IN INDUSTRY [DOSTIZHENIYA V OBLASTIC KOSMICHESKOGO MATERIALOVEDENIYA I IKH ISPOL'ZOVANIYE V PROMYSHLENNOSTI]
G. G. Konradi, V. V. Kozelkin, L. A. Novitskiy, and V. V. Shvarev Washington NASA Sep. 1968 6 p Transl. into ENGLISH from Paper A/Conf. 34/VI/17 Presented at the United Nations Conf. on the Exploration and Peaceful Uses of Outer Space, Vienna, 14–27 Aug. 1968
(Contract NASw-1695)
(NASA-TT-F-11938) CFSTI: HC $3.00/MF $0.65 CSCL 11

The unique environment encountered by objects launched into space creates special materials engineering problems. The authors describe several new types of materials designed to cope with space conditions, but valuable for earth surface use as well. They include: FT-40, an improved Teflon; heat resistant polymers; self-lubricating friction surfaces and low volatility lubricants.
Author

N68-35615 National Lending Library for Science and Technology, Boston Spa (England).
EXTRUSION OF RIGID PVC FILMS
B. Georgii Mar. 1968 11 p refs Transl. into ENGLISH from Kunststoff-Rundschau (Hamburg), v. 14, no. 7, Jul. 1967 p 317–320
(TRANS-1534) Available from Natl. Lending Library, Boston Spa, Engl. $15.00 or 6£

Various solutions to the difficulties encountered in manufacturing rigid PVC films by extrusion are discussed. In single-screw extruders, difficulties due to variations in dwell-time can be reduced by forced feeding. Particular attention must be paid to geometric features and correct temperatures to obtain optimum performance. The output of single-screw extruders is limited by a maximum speed of revolution. The use of double-screw extruders of the same revolution count approximately double the performance. For manufacturing thin films, extensibility is very important economic feature. Two independent extensibility maxima occur at different temperatures, one in the elastic zone and the other in the plastic zone. Film extension in both wide-slit and blow extrusion methods occurs partly in the plastic and partly in the elastic zone. Optimum

conditions are more readily effected in the first method, with which a high output performance, a good surface and good transparency can be obtained. Features of two commercially available wide-slit extruders are described, the second being a four-screw unit with oil controlled cylinder temperatures. Author

N68-35648 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
FORGED STEEL PROPERTIES STUDIED BY THE MEASUREMENT OF THE ULTRASONIC ATTENUATION COEFFICIENT [ESTUDO DAS PROPRIEDADES DO ACO FORJADA POR MEIO DA MEDIDA DA ATENUACAO ULTRA-SONICA]
L. X. Nepomuceno, C. Mendonca Filho and H. Onusic [1968] 24 p refs In PORTUGUESE; ENGLISH summary Presented at the 20th Ann. Meeting of the Brasil. Soc. for Sci. Progr., Sao Paulo, 12 Jul. 1968 Submitted for publication
(Rept.-6806/E-11)

The report describes the instruments, procedure and results obtained with the studies searching a connection between the steel properties and the ultrasonic attenuation coefficient. The most relevant result was the connection between the attenuation coefficient and the carbon content, for mild steel. This preliminary result will permit that the study be continued in the same line. Author

N68-35680 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF WING SPAR ATTACHMENT JOINT NO. 1 LUG B IN VISCOUNT AIRCRAFT
C. Mendonca Filho 28 Jun. 1968 6 p
(TR-6806.328-B)

The reports describes the procedure, equipment and accessories used in the ultrasonic inspection of the wing spar attachment joint number 1 in Viscount aircraft, in order to observe crack growth and development. Author

N68-35679# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
SINTERING UO_3 TO DENSE UO_2
G. Rolland Cole and P. Kent Smith May 1968 15 p refs
(Contract AT(07-2)-1)
(DP-1085) CFSTI: HC $3.00/MF $0.65

Sintering of compacted hydrated UO_3 at 1600°C in hydrogen produced $UO_{2.08}$ pellets with bulk density of only 90% of theoretical, 5% less than the UO_2 density desired. The effects on UO_2 density of temperature, hydration, compacting pressure, ball milling, and additives are described. Author (NSA)

N68-35686# Technische Hogeschule, Delft (Netherlands). Afdeling der Werktuigbouwkunde.
THE MOTION OF THE BALLS IN AN UNLUBRICATED ANGULAR CONTACT THRUST BALL BEARING
J. J. Kalker Apr. 1968 28 p refs
(WTHD-2; Rept.-389) CFSTI: HC $3.00/MF $0.65

The motion of the balls in an unlubricated angular contact thrust ball bearing is analysed. The results can be used to calculate the dissipation due to surface friction and to compute the orbit of the balls. The material is presented in order of increasing complexity. First, the case of identical contacts in slowly rotating bearings is considered, and it is found that the balls roll with pure spin. A simple calculating scheme is presented for the determination of the statical indeterminacies. Second, the case of nonidentical contacts in slowly rotating bearings is considered; here it turns out that apart from spin there is also an amount of lateral creepage present in the rolling motion of the balls. Third, the effect of a centrifugal force is taken into account. It is found in all three cases that equilibrium of the ball is possible without any interaction with the cage. Nonetheless it is of interest to know what happens when there is strong interaction with the cage; this analysis is performed also. Finally some remarks are made regarding the stability of the motion of the balls. Author

N68-35715*# DeBell and Richardson, Inc., Hazardville, Conn.
PREPARATION OF FILAMENT WOUND MICROTAPE RESEARCH SPECIMENS
5 Jul. 1968 49 p refs
(Contract NAS3-3647)
(NASA-CR-72459; Rept.-697.1) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The objective of this project was the forming of low permeability, thin-walled tubes suitable for containing cryogenic liquids, with no liner, from rectangular glass fibers and resin. In order to achieve these results, it was necessary to refine the filament forming process to produce glass filaments with a high aspect ratio, flat rectangular cross section. A guiding and precision winding technique had to be developed to obtain the desired edge-to-edge, flat layered structure. An acid polishing process was worked out to provide low surface flaw count preforms from which to draw higher strength microtape. A means of dynamically monitoring the microtape width was developed to assist in precision winding. Strengths measured by internal burst and straight axial tensile, gave results below the modest strength of the microtape filament. It is indicated that a resin and coupling agent system which would bond better and have higher elongation should be developed to fully utilize the potentialities of glass microtape filament wound structures while the strength of the microtape itself should be further improved. Author

N68-35716# Technische Hogeschool, Delft (Netherlands). Afdeling der Werktuigbouwkunde.
EDUCATION IN LUBRICATION AND WEAR AND ITS CONCEPTUAL INTEGRATION INTO MACHINE DESIGN
Harmen Blok Jun. 1968 27 p refs Presented in Session 1 of the 3d Intern. Conf. on Lubrication and Wear, London, 25-29 Sep. 1967
(WTHD-8) CFSTI: HC $3.00/MF $0.65

The paper points out why the rationalization of education in lubrication and wear, through its conceptual integration in machine design, is indispensable for the future development of machinery and, therefore, for that of national economies. The paper is mainly devoted to outlining a philosophy of approach in education, based on broad unifying principles and concepts that are tangible to those having to apply them, i.e. the designers of machinery. By means of this philosophy one may achieve the conceptual integration of education in lubrication and wear into machine design. The philosophy also meets the demand for organizing the bewildering store of present-day knowledge on lubrication and wear, both of a fundamental and an empirical nature. The ensuing classification of the various states of lubrication and types of mechanical wear rests mainly on the distinction between "conformal" and "counterformal" rubbing surfaces. This distinction runs broadly parallel to, amongst other things, the nature of contact, the potentialities for achieving full fluid film lubrication. Author

N68-35768*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE POWER TOOLS
Isaac Edmond 18 Jul. 1968 23 p refs
(NASA-TM-X-53730) CFSTI: HC $3.00/MF $0.65 CSCL 13I

This report is a digest of several technical papers reviewed and combined on the subject of power tools proposed for use in in-space manufacture, assembly, and maintenance operations. Six types of tool power sources were reviewed: (1) electric motor, (2) gas turbine, (3) thermite fueled steam generator, (4) monopropellant powered impulse device, (5) cartridge driven impact devices, and

(6) advanced electric motor or brushless dc motor. The brushless dc motor met most safety requirements for use in space environments and is considered to give the most promise for space power tools. Author

N68-35791# Technische Hogeschool Delft (Netherlands).
SOME ASPECTS OF THE INFLUENCE OF SULFUR, LEAD AND TELLURIUM ON THE CUTTING FORCES IN CUTTING LOW CARBON STEELS
C. Spaans [1967] 23 p refs Presented at C.I.R.P., Ann Arbor, Mich., 30 Sep.–5 Oct. 1967
CFSTI: HC $3.00/MF $0.65

The paper contains a survey concerning cutting tests on low carbon steel to which respectively sulfur, sulfur and lead, and sulfur, lead and tellurium has been added. The cutting forces, the chip-tool contact length, the height of the zone of secondary deformation underneath the chip, and the extra forces near the cutting edge, via the chip flow angle and the cutting ratio in oblique cutting, have been determined in order to find the causes of the decrease of the cutting forces due to the various additions mentioned above. Author

N68-35797*# Electro-Optical Systems, Inc., Pasadena, Calif.
THE DEVELOPMENT OF TECHNOLOGY REQUIRED FOR THE SUCCESSFUL DEPOSITION OF ALUMINUM ALLOYS AND BERYLLIUM
Ronald Guidotti and Kenneth Lui [1968] 109 p refs
(Contract NAS1-7418)
(NASA-CR-66344; EOS-7248-Final) CFSTI: HC $3.00/MF $0.65
CSCL 13H

Trial syntheses of beryllium Grignards yielded insufficient quantities of material required for the successful electrodeposition of beryllium. Aluminum-alloy and hardened-aluminum plating baths were developed through the use of inorganic and organic compound additives to an aluminum plating bath ($AlCl_3$ and $LiAlH_4$ in diethyl ether). The ultimate yield strength of aluminum deposits from the improved baths was in the range of 145–228 MN/m² (21K to 33K psi). A voltammetric technique using a triangular waveform was used to scan a large number of electrolytes in uncovering the improved plating baths. The triangular-wave voltammetric scan also was found to be a useful method in monitoring for signs of deterioration of the plating bath. Author

N68-35859# Pennsylvania State Univ., University Park. Dept. of Materials Science.
POWDER METALLURGY TECHNIQUE FOR THE PREPARATION OF $HoZn_2$ SAMPLES
David J. Michel and Earle Ryba 23 May 1968 9 p refs
(Contract AT(30-1)-3560)
(NYO-3560-8) CFSTI: HC $3.00/MF $0.65

Equipment and procedures used in preparing compacts of an intermetallic compound, $HoZn_2$, for mechanical properties measurements are described. NSA

N68-35906# Massachusetts Inst. of Tech., Cambridge. Spectroscopy Lab.
EXTENSION OF TECHNIQUES FOR RULING LARGE DIFFRACTION GRATINGS Final Report, 1 Jun. 1967–31 May 1968
George R. Harrison 31 May 1968 7 p
(Grant NSF GP-6115)

The interferometrically-controlled ruling engine of 18 × 12 inch capacity, referred to as the B engine, has now been brought to the stage of development where it produces gratings which are the equal of those produced by the 10 inch A engine in resolving power, brightness, and freedom from ordinary ghosts, and are of much higher quality in weakness of scattered light, of false lines sometimes known as "walking Lyman ghosts", and of satellites. Every indication points to the superior performance of this engine to any previously constructed. The interferometrically-controlled C engine of 24 × 18 inch capacity is now ready for producing rulings routinely, and has already produced some 10 test gratings, ranging from a few inches up to 12 inches in ruled width. This engine too shows superior characteristics to engine A apart from its great size, and we should be able to rule large gratings on it within a very short time. During the past year 12 gratings have been ruled on the B engine, most on 10 inch blanks, and 10 have been ruled on the C engine, several on 12 inch blanks. Both engines have now demonstrated their reliability for ruling over more than 12 inches of blank at 300 grooves per mm. Author

N68-35911# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
SIMPLIFIED METALLOGRAPHIC TECHNIQUE FOR BERYLLIUM
Arthur E. Calabra, Don L. Marts, and James F. Capes 12 Jun. 1968 9 p refs
(Contract AT(29-1)-1106)
(RFP-1124) CFSTI: HC $3.00/MF $0.65

A simplified metallographic technique for vacuum-cast rolled ingot beryllium sheet and powder pressed beryllium has been developed. This technique is such that the beryllium metallographic specimen needs only to be ground through 600-grit (soft) silicon carbide paper and electrolytically polished. This simplified technique yields polarized light delineation of the microstructure; however, inclusions are not retained. A more precise technique, is described for the preparation of high quality metallography of powder pressed material. Author (NSA)

N68-35935# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELECTION OF DIE STEELS FOR HIGH-SPEED METAL-FORMING TOOLS [K VOPROSU O VYBORE SHTAMPOVYKH STALEI DLYA INSTRUMENTA VYSOKOSKOROSTNOGO DEFORMIROVANIYA METALLOV]
Yu. P. Sogrishin, M. A. Gaponov, and A. N. Zhuchenko 19 Sep. 1967 13 p refs Transl. into ENGLISH from Nauch. Tr. Eksperim. Nauchn.-Issled. Inst. Kuznecho-Pressovogo Mashinostroeniya (Moscow), no. 13, 1966 p 104–114
(FTD-MT-24-190-67; AD-673821)

Three tool steels were tested for their suitability as die materials in high energy rate of aluminum, steel, titanium and nickel based alloys. TAB

N68-35989# Atomic Weapons Research Establishment, Aldermaston (England).
THE PRODUCTION OF FINE METAL POWDERS USING GRINDING AIDS
R. A. Knight and C. A. Calow Apr. 1968 13 p refs
(AWRE-O-039/68) CFSTI: HC $3.00/MF $0.65

The object of the work described was to reduce −200 mesh Ni–Cr alloy powders to <10 μm particles size using mechanical comminution techniques. The addition agents were chosen mainly for their low sublimation and decomposition temperature since a decomposition process was selected to remove the grinding aid. NSA

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-34954 Ohio State Univ., Columbus.
PHENOMENOLOGICAL ELECTRODYNAMICS IN AN ACCELERATED SYSTEM OF REFERENCE
John Andrew Little (Ph.D. Thesis) 1967 105 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-16300

The electrodynamics in an accelerated system of reference is examined by observing the effect of macroscopic matter on the beat frequency of a rotating closed-path optical maser. A review of the theoretical development is presented utilizing a plane wave expansion for the electromagnetic field in the cavity. Three basic invariants, i.e., the phase, the square of the wave vector, and the transformation of frequencies, are used to determine the effective index of refraction as measured by an observer in the accelerated system. This index of refraction is utilized in the resonant condition for a closed path to determine a first order approximation for the frequency separation between the clockwise and counterclockwise traveling wave modes in the presence of dispersive media or media moving with respect to the cavity. This expression is further shown to be consistent with a formulation obtained from a consideration of Minkowski's energy-momentum tensor for an almost plane wave expansion of a beam of finite cross section. Dissert. Abstr.

N68-35099*# Tennessee Univ., Tullahoma. Space Inst.
APPLICATION OF NEGATIVE FEEDBACK TO REDUCTION OF GLOW DISCHARGE NOISE
C. W. Bray, F. M. Shofner, and T. B. Carlson Washington NASA Sep. 1968 23 p refs
(Grants NGR-43-001-021; NSF GK-1638)
(NASA-CR-1173) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Several researchers have studied the problem of discharge current modulation noise in the output radiation intensity of a d-c excited He-Ne laser. Work presented herein uses an analog circuit to demonstrate the feasibility of using negative feedback to reduce the discharge current noise and thereby reduce noise in the output radiation intensity. Author

N68-35175*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
SURVEY OF CO_2 LASER DEVELOPMENT FOR SPACE APPLICATIONS
Thomas R. Lawrence Washington Sep. 1968 51 p refs
(NASA-TN-D-4794) CFSTI: HC $3.00/MF $0.65 CSCL 20E

This report presents the status of CO_2 laser development. The first application of a CO_2 laser is expected to be in the development and testing of an optical communication link from a synchronous orbit to Earth using heterodyne detection. The transmitter for this link will be a small, low-powered, space-qualified CO_2 laser with stable, single frequency, single mode operation, and dependable, long operating life. In this report, the brief history of CO_2 laser development is surveyed and a simplified qualitative discussion of the CO_2 laser and the various additives is presented. Then the current level of development is compared to what is desired. It is found that the CO_2 laser is especially suited for single frequency operation; stable, single frequency CO_2 lasers have been built and tested in heterodyne communication systems in the laboratory. Many of the requirements for space qualification can be met by proper design. Author

N68-35428# RAND Corp., Santa Monica, Calif.
ELECTROMAGNETIC FIELD AND INTENSITY FLUCTUATIONS IN A WEAKLY INHOMOGENEOUS MEDIUM
H. T. Yura Jul. 1968 40 p refs
(Contract F44620-67-C-0045)
(RM-5697-PR; AD-672955)

A self-consistent Greens function technique is used to obtain the electromagnetic field and its corresponding intensity to second order in the index of refraction fluctuations. It is found that for propagation distances less than a critical length, the perturbation method gives valid results. The field is primarily coherent since the fluctuations in the field are small. The solution obtained for the field is also shown to conserve energy. When the solution obtained here is compared with the results of the Rytov approximation, it is concluded that the Rytov approximation is not valid for propagation distances exceeding the critical length. For these distances, the perturbation method breaks down; the field is essentially incoherent since the coherent component of the field is exponentially small. For these range values, a statistical argument is given to obtain intensity statistics, and an approximate expression valid for all range values is derived for the intensity statistics. This expression is found to be in good agreement with experiment. Author (TAB)

N68-35445# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION AND DEVELOPMENT OF OPTICAL MODULATORS [ISSLEDOVANIE I RAZRABOTKA OPTICHESKIKH MODULYATOROV]
I. V. Pirshin, M. M. Koblova, V. I. Khlystov, and E. V. Antonyants Oct. 1967 12 p refs Transl. into ENGLISH from Sci. and Tech. Soc. of Radio Eng. and Electrical Communication, Central Government 22 All-Union Sci. Session, Sec. of Quantum Electron. (Moscow), 1966 p 33-40
(FTD-MT-24-222-67; AD-672693)

A device using a symmetrical Michaelson interferometer with double refracting diagonally cut crystals in the arms was developed. The latter are controlled by a field at right angles to the direction of propagation. The power required to control the modulator can be lowered by increasing the length of the crystal and decreasing its cross section. Details on the thermal expansion of various parts and materials are given and the effects of expansion on modulator operation are described. The modulator was tested between 0 and 100 Mc with a control voltage of 150 v. The model was tested in an experimental transmission of a television picture with the aid of a laser beam. TAB

N68-35566# Joint Publications Research Service, Washington, D. C.
SEMICONDUCTOR QUANTUM GENERATOR WITH EXTERNAL RESONATOR [POLUPROVODNIKOVYY KVANTOVYY GENERATOR S VNESHNEM REZONATOROM]
N. G. Basov, O. V. Bogdankevish, A. N. Pechenov, A. S. Nasibov, and K. P. Fedoseyev 24 Sep. 1968 20 p refs Transl. into ENGLISH from Acad. of Sci., Moscow, Preprint No. 109, 1968
(JPRS-46504)

Using a semiconductor quantum generator (SQG) with an active substance in the form of a thin layer with an external resonator permits a considerable increase in the power and an improvement in the directability of the coherent radiation. In the present paper, the dependence of the power and threshold of generation in such a generator based on gallium arsenide during excitation by an electron beam on the diameter of the active region is investigated. With a diameter of 0.21 mm and an electron energy of 190 keV, a power of 900 ± 90 W was obtained with an efficiency of 25 ± 5%. Using a complex resonator with an external mirror, the pattern of directability of the SQG radiation was narrowed significantly (to 45°). Author

N68-35593*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STUDY OF PLASMA DIAGNOSTICS USING LASER INTERFEROMETRY WITH EMPHASIS ON ITS APPLICATION TO CESIUM PLASMAS
Richard B. Lancashire Washington Sep. 1968 21 p refs
(NASA-TM-X-1652) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A review of the background and current development of gas-laser diagnostics is presented. Included is a résumé of the plasma refractive index and the experimental techniques of the three-mirror laser interferometer and the laser heterodyne system. Sensitivity of the two techniques to electron and neutral-particle densities is covered with emphasis placed on the application of the techniques to a cesium plasma contained in a thermionic diode. The spatial resolution of the techniques as applied to a cesium diode is also presented. Author

N68-35877# California Univ., Livermore. Lawrence Radiation Lab.
LARGE APERTURE GLASS DISC LASER SYSTEM
J. E. Swain, R. E. Kidder, K. Pettipiece, F. Rainer, E. D. Baird et al 14 May 1968 28 p refs Presented at Intern. Quantum Electron. Conf., Miami, Fla., 13–17 May 1968 Supported by AEC (UCRL-70849; CONF-680522-1)

A study of a glass laser designed to operate at extremely high power and brightness for possible use in the production of strong shock waves and high-temperature plasmas is presented. The design, which uses tilted face-pumped discs of neodynium-doped glass, is a most promising approach to such applications. The advantages and disadvantages of the four proposed ways to use such a laser are considered. To test the disc concept, a system of five 12.5-cm-diameter, 1.25-cm-thick discs was constructed. Design considerations and the results of several measurements with the experimental system are presented. Measurements of the single-pass gain of the five discs showed a gain coefficient of 0.054/cm, which indicates an energy storage of 0.68 joule/cm^3 or 100 joules per disc. The design of a 15-disc unit with a 90-meter path facility, now under construction for continuing experimentation, will be brought to full power (near the damage limit). Author (NSA)

N68-35924# Royal Aircraft Establishment, Farnborough (England).
GENERATION OF THE SECOND OPTICAL HARMONIC IN THE RESONATOR OF A LASER [GENERATSIYA DRUGOI OPTICHNOI GARMONIKI V REZONATORI LAZERA]
I. O. Marushko and V. S. Mashkevich Jun. 1968 19 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 10, no. 3, 1965 p 312–322
(RAE-LIB-TRANS-1300) CFSTI: HC $3.00/MF $0.65

The emission of a laser with an nonlinear crystal in its resonator was investigated. Various regions of laser excitation are considered in detail. The effect of second harmonic generation on the state of the special mode in these regions is studied. Conversion coefficients of the fundamental frequency into the second harmonic are obtained for different excitation levels. The ratios giving the losses at the fundamental and harmonic frequencies for stable working of the laser are found for the maximum conversion of the fundamental frequency into the second harmonic. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-34849 Northwestern Univ., Evanston, Ill.
SOLID STATE PHASE EQUILIBRIA IN COBALT RICH Co-WC ALLOYS
Anthony Francis Paul Giamei (Ph.D. Thesis) 1967 340 p
Available from Univ. Microfilms: HC $15.30/Microfilm $4.35 Order No. 67-15237

The present research provides an essential key to the understanding of the cobalt rich matrix phase in Co-WC alloys. The properties of the cobalt base refractory carbide particulate composites can only be interpreted with respect to the crystal structures and properties of the individual components. The state of the matrix as a function of thermo-mechanical history is of primary importance. The extension of the thermal martensite transformation temperatures is made into the Co-WC isopleth section of the Co-W-C ternary system by means of dilatometry. The metallographic interpretation of the resultant microstructures is provided. A method is presented for the determination of the orientation of a single grain in a polycrystalline sample by a one surface analysis when transformation markings are present. These results are correlated with X-ray diffraction data. The M_d temperature is also located with respect to room temperature as a function of alloy composition. Dissert. Abstr.

N68-34850 Pennsylvania State Univ., University Park.
ANNEALING KINETICS OF POINT DEFECTS IN CHROMIUM
Robert Judson Baltz (Ph.D. Thesis) 1967 89 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-15378

The general purpose of this investigation was to study the annealing kinetics of a supersaturation of point defects introduced into chromium by plastic deformation. It was hoped that, among other things, such an investigation would supply the activation enthalpy of vacancy migration. This quantity is of interest, relevant to interpretation of the problem of the anomalous self-diffusion behavior observed in chromium and in certain other bcc metals. Since one of the most difficult aspects of this work involved the production of suitable chromium wire specimens, a detailed discussion was given of the method of specimen preparation. Dissert. Abstr.

N68-34872 Texas Univ., Austin.
THE EFFECTS OF STRAIN-RATE AND TEMPERATURE ON THE STRESS-STRAIN CHARACTERISTICS OF COPPER AND IRON
Hal Watson, Jr. (Ph.D. Thesis) 1967 190 p
Available from Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 67-14899

A technique is described for determining stress-strain characteristics of metals at high temperatures under impact loading conditions by directly measuring the stress and the strain independently inside the high temperature environment. The average stress over the cross section of a short, right-circular cylindrical specimen is measured by means of a thin piezoelectric crystal. The average strain over the cross section as a location on the lateral surface of the specimen very near the quartz is measured simultaneously with the stress by means of a special, high-temperature, ceramic based, wire-resistance strain gage. The gage is the free-filament type, being attached by means of the flame-spray process, in which the base coatings and overlay coverings of ceramic are sprayed on while molten. Limited by temperature and strain ranges, the technique has been used from room temperature up to 1000°F at strain-rates up to 2000 sec^{-1} and is accurate up to 0.8% strain. Use of the technique to determine the stress-strain characteristics of commercially pure copper and iron in these ranges of strains and temperatures revealed that the stress-strain characteristics of each material in uniaxial compression may be approximated mathematically. Dissert. Abstr.

N68-34899 Case Inst. of Tech., Cleveland, Ohio.
CONTROL OF CAST STRUCTURE OF ALLOYS FOR HIGH TEMPERATURE SERVICE

Stephen Frederick Ramseyer (Ph.D. Thesis) 1966 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-11568

From a survey of the Ni-W and Co-W systems, it was shown that the majority of the binary alloy structures could be successfully modified with substantial improvements in stress rupture properties. From this survey a Co-35W composition was chosen for further investigation and development. In subsequent alloying of the base Co-35W alloy, it was determined that additions of Cr, Ti, Zr and C refined and modified the base structure, thus imparting improved properties. Using a base alloy of Co-35W-3Cr it was found that the atomic ratio of Ti plus Zr to C determined both the type and morphology of the second phases that formed. The addition of Mo, V, Ta+Nb and N to a Co-35W-3Cr-1Ti-1Zr-.5C-.1B alloy adversely influenced both structure and properties. Several of the alloys investigated had better stress rupture lives at 1850°F than the majority of cobalt-base superalloys cited in the literature. Dissert. Abstr.

N68-34959 Case Inst. of Tech., Cleveland, Ohio.
TEMPERATURE SENSITIVE DUCTILITY IN SOME COPPER ALLOYS
John Wilbur Kochera (Ph.D. Thesis) 1967 115 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-16081

Variations in tensile ductility as measured by percent reduction of area for nine alpha solid solution copper alloys were dependent on test temperature, solute species, solute content, and grain size. Temperature sensitive ductility losses below ambient temperature in alloys of copper with tin, silicon, and aluminum were correlated with the ease of formation and the extent of localized plastic shear zones. Dilute alloys had broad zones at all test temperatures and the ductility changes were small. In the high solute alloys, where the losses were greater, shear zones were more concentrated at low temperatures. The ductility losses were highest for a Cu-Sb alloy and resulted from the onset of grain boundary cracking with little difference in the width of the shear zones at different temperatures. A correlation of the temperature sensitive ductility losses and the temperature sensitivity of the yield stress was observed. Dissert. Abstr.

N68-35033 Case Inst. of Tech., Cleveland, Ohio.
HYDROGEN PERMEABILITY IN A STABLE AUSTENITIC STAINLESS STEEL
Jon Henry Shively (Ph.D. Thesis) 1967 77 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-16102

Hydrogen permeation rates were measured through a stable austenitic stainless steel at ambient temperature as the result of impressed cathodic currents. In the passive condition in H_2SO_4 the permeation rate depends on the applied current, while in the active condition the rate depends on surface corrosion currents and the applied current. Experiments under anodic currents showed that entry is stopped in the H_2SO_4, but not in HCl or NaCl solutions. Evidence of coupled action between local attack and hydrogen entry suggests a potential role of hydrogen in stress corrosion cracking in chloride environments. Dissert. Abstr.

N68-35070 Northwestern Univ., Evanston, Ill.
DECOMPOSITION IN ALUMINUM ZINC ALLOYS
Karl Bernhardt Rundman (Ph.D. Thesis) 1967 217 p refs
Available from Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 67-15329

The kinetics of decomposition in four Al-Zn alloys of nominal compositions 14, 22, 37 and 61 at. pct. zinc were studied by isothermal resistance measurements, metallographic measurements, high-angle X-ray diffraction and small-angle X-ray diffraction. Small-angle scattering spectra were also obtained for the 22 at. pct. zinc alloy aged at 125°C and 150°C. The maximum in the as-quenched spectral intensity was a strong function of both composition and quenching rate. The isothermal aging kinetics following a quench in the 14, 37 and 61 at. pct. zinc alloys were studied by the small-angle scattering technique, but results were used only qualitatively. Isothermal resistance changes on a quenched and aged 14 at. pct. zinc alloy showed that the rate of decomposition (rapid clustering of zinc-rich zones) was controlled by the quenched-in vacancy concentration. A discontinuous precipitate containing the hcp zinc-rich phase and an fcc aluminum-rich phase was observed metallographically in the 22, 37, and 61 at. pct. zinc alloys. Isothermal resistance measurements on a 61 at. pct. zinc alloy revealed a very rapid reaction immediately after quenching (observed as a large resistance increase), and before the nucleation of the discontinuous precipitate. Dissert. Abstr.

N68-35087 Arizona Univ., Tucson.
INVESTIGATIONS OF ORDERING PHENOMENA IN AUSTENITIC ALLOYS
Walter Ray Roser (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-16512

Previous research on austenitic Fe-Cr-Ni alloys resulted in observations that were inconsistent with existing theories. These observed inconsistencies can be explained by the presence of order (either long-range order or short-range order) in the alloy system. No concrete evidence for the existence of order in Fe-Cr-Ni alloys has ever been obtained. The present research was undertaken to determine whether or not ordering existed in this alloy system. Four alloys were selected for investigation. These were: Type 304 stainless steel; Fe, 25at. %Ni, 10at. %Cr; Fe, 25at. %Ni, 25at. %Cr; Fe, 40at. %Ni, 20at. %Cr. Electron microscopy and electrical resistivity measurements were used as investigational methods. Definite evidence of short-range order was found in the Fe, 25at. %Ni, 10at. %Cr, Fe, 25at. %Ni, 25at. %Cr and Fe, 40at. %Ni, 20at. %Cr alloys. This evidence was in the form of high apparent stacking fault energy, coplanar arrays of dislocations and dislocation pairs of like sign. Dissert. Abstr.

N68-35088 Case Inst. of Tech., Cleveland, Ohio.
INTERNAL FRICTION AND EMBRITTLEMENT IN HYDROGEN CHARGED AUSTENITIC STEEL
John Adolf Peterson (Ph.D. Thesis) 1967 74 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 67-16095

The internal friction of a stable austenitic stainless steel containing hydrogen was measured at 80 kc/sec between 77°K and room temperature. Two relaxation peaks were found after cathodic charging of this fcc material with hydrogen. A sharp peak occurred at 206°K which was attributed to an interstitial hydrogen-substitutional atom pair mechanism. A broad peak was found at about 225°K which was believed to result from a hydrogen-dislocation interaction. Room temperature and 77°K deformation of the as-charged material produced a redistribution of the hydrogen and gave evidence of hydrogen trapping. Strategically selected tensile tests of hydrogenated type 310 stainless steel were performed. A low temperature prestrain of charged and aged material produced almost complete recovery of ductility. A direct correlation was made between the internal friction and mechanical behavior. Dissert. Abstr.

N68-35089 Case Inst. of Tech., Cleveland, Ohio.
THE DEFORMATION OF TANTALUM ALLOY SINGLE CRYSTALS
Peter Louis Raffo (Ph.D. Thesis) 1967 205 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-16512

A study was made of the deformation of Ta-Re, Ta-W and Ta-Mo alloy single crystals in the temperature range 77 to 623°K. Primary emphasis was on the alloys in the Ta-Re system. Slip was found to occur on {110} planes at 77 and 298°K. Three-stage work hardening was not observed in the alloys and the rate of work hardening at low strains was characteristic of Stage II in the pure metal. Work softening was noted at high strains in the more concentrated alloys. The yield stress increased continuously with alloying above room temperature while at low temperatures, it first decreased with alloying and passed through a minimum before increasing again with composition at higher concentrations. The rate of alloy hardening was considered for several bcc alloy systems at 298°K and it was found that the predominant interaction was with the strains around misfitting solute atoms. The decrease in yield stress at low temperature was attributed to a decrease in the Peierls stress. The increase in yield stress was due to the overcoming of the stress fields of individual solute atoms. Clevage occurred in tension at high compositions and low temperatures in Ta-Re alloys. This was attributed to a decrease in the rate of dislocation multiplication through a decrease in the ease of cross slip. Confirmation for this was found in the presence of screw dipoles in transmission electron micrographs in Ta-10.6% Re deformed at 298°K. Dissert. Abstr.

N68-35090 Purdue Univ., Lafayette, Ind.
THE DIFFUSION OF HYDROGEN IN ALPHA AND BETA TITANIUM
Thomas Polydor Papazoglou (Ph.D. Thesis) 1967 126 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-16698

Hydrogen diffusion in HCP and BCC titanium in the temperature range 610°–900°C was measured by exposing cylindrical specimens of high-purity titanium at constant temperature to small constant pressures of hydrogen, of the order of a few torr. In the range 0 to 6.7 atomic %H in HCP titanium the diffusion coefficient D in cm^2/sec is given by $D = 3.0 \times 10^{-2} \exp(-14{,}700 \pm 650/RT)$ where T is in °K and R is in cal/mole-°K. Only three measurements of D in BCC titanium were made. At 900°K the diffusivity was found to be 1.8×10^{-4} cm^2/sec. A possibility of concentration dependence of the diffusivity exists in the BCC phase. Dissert. Abstr.

N68-35091 Purdue Univ., Lafayette, Ind.
STRAIN INDUCED REVERSAL OF MARTENSITE TO AUSTENITE IN Fe–Ni–C ALLOYS
Robert Joseph Russell (Ph.D. Thesis) 1967 200 p
Available from Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 67-16704

The strain-induced reversal of martensite resulting from impact shear was studied in Fe–Ni–C alloys with nickel-to-metal atom ratios from .049 to .238 and carbon-to-metal atom ratios from .000 to .039. Martensitic specimens, in the form of thin (about .009 inch to .017 inch) washers, were rapidly strained in shear by means of a specially-designed impact apparatus; the specimens were at room temperature immediately prior to shearing. The shearing apparatus used consisted of a cylindrical assembly (which included a notched tensile bar) that was designed to fit between the crossheads of a tensile machine. The unloading compressive wave initiated by breaking the notched bar activated a concentric die set, which caused the specimen to yield in shear. During the test, the shearing force supported by the specimen was recorded as a function of time. Metallographic examination of sections taken across the sheared regions of the tested specimens revealed zones in which the shear strain had localized. Dissert. Abstr.

N68-35093# Bureau of Mines, Reno, Nev.
FIELD FREEZING OF A CERIUM–IRON ALLOY
J. E. Murphy, E. Morrice, and T. A. Henrie Oct. 1968 16 p refs
(BM-RI-7186)

Field freezing was used by the Bureau of Mines to effect the redistribution of the components in a cerium-12.5-atomic-percent-iron alloy. The application of the electric field caused the iron to migrate toward the anode. A field intensity of 0.04 v/cm and a current density of 240 amp/cm^2 were used. The conditions that yielded the greatest redistribution of alloy components were a small thermal gradient along the specimen (from 5° C/cm to 10° C/cm) and a very slow freezing rate (0.15 cm/hr). Under these conditions it was possible to process specimens of 1/2-inch diameter as compared with the capillary-size specimens used by most previous investigators. Author

N68-35095# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
MICROFLOTATION STUDIES OF SOME COLUMBIUM–TANTALUM MINERALS
Andrew J. Fergus and Gerald V. Sullivan Oct. 1968 34 p refs
(BM-RI-7189)

A study of the flotation characteristics of columbium–tantalum minerals was made by contact-angle and microflotation methods, and the findings were confirmed by flotation of two natural ores. In the contact-angle study conditions for collection of columbite, pyrochlore, and tantalite were determined for (1) sodium oleate with a sulfonate; (2) sodium isooctyl phosphate; (3) a short-chain primary amine; (4) a long-chain primary amine; and (5) a quaternary amine. These conditions were confirmed in microflotation tests. Information about collector action on common gangue minerals was also obtained by these two methods. In batch flotation tests on a pyrochlore ore and a columbite ore, it was demonstrated that collectors selected on the basis of contact-angle and microflotation studies would float columbium minerals from a complex natural ore. However, multiple cleaner and scavenger flotation steps will be necessary to produce commercial concentrates. From a pyrochlore ore containing 0.54 percent Cb_2O_5, a 44.4 percent Cb_2O_5 concentrate was made containing 36.4 percent of the total Cb_2O_5. For a columbite ore the corresponding values were: 4.35, 54.6, and 67.1 percent. During the batch flotation study, wetting agents were found to aid in the gangue-ore mineral separations. Author

N68-35098*# Bendix Corp., Madison Heights, Mich.
OXIDATION RESISTANT MATERIALS FOR TRANSPIRATION COOLED GAS TURBINE BLADES. 2: WIRE SPECIMEN TESTS
Fred W. Cole, James B. Padden, and Andrew R. Spencer Washington NASA Sep 1968 125 p ref
(Contract NAS3-7269)
(NASA-CR-1184) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Four alloys were selected on the basis of sheet specimen tests, reported in Summary Report CR-930, and tested in 0.005 inch diameter wire form to determine their suitability for use as transpiration cooled gas turbine blade materials. The alloys were N 155, TD nickel-chromium, DH 242, and Hastelloy X. Tests consisted of cyclic oxidation, continuous oxidation, stress rupture life, and stress-oxidation at 1400, 1600, 1800, and 2000°F, and up to 2100 and 2200°F for some tests. Exposure times ranged up to 100 hours except for cyclic oxidation tests where times were 4, 16, 64, 100, 100, 300, 400, 500 and 600 hours. Total specific oxidation weight gain, oxide spall and penetration, and mechanical properties were determined for each alloy. Metallographic examination showed microstructure and oxidation effects. TD nickel-chromium was superior, except for stress sensitivity resulting in internal oxidation. All alloys were limited to a useful service temperature near 1600–1700°F. Author

N68-35143*# Dow Chemical Co., Midland, Mich.
R AND D AND EVALUATION OF A LIGHTWEIGHT, HIGH STRENGTH MAGNESIUM ALLOY Annual Report, 26 Apr. 1967–26 Jul. 1968
George S. Foerster and Harold A. Diehl 26 Jul. 1968 42 p refs
(Contract NAS5-10398)
(NASA-CR-96888) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Mg alloys containing up to 36% Sc and with ternary additions of Ag, Cd, Li, Zn, Zr, Mn, Y, Al, Pb, Sn, and Bi were evaluated on a small laboratory scale. Sc markedly improves the properties of Mg extrusions. Mg-30Sc offers high strength (50–60,000 psi), adequate ductility (7–11% elongation), high modulus ($8–9 \times 10^6$ psi), and good high temperature properties—a combination of properties far superior to that of any Mg alloy yet developed. Ternary additions of Li, Ag, Cd, and Zn improve the properties of Mg-Sc and provide high strength at relatively low Sc levels. Of particular interest is Mg-10Sc-5Li which age hardens at room temperature to a yield strength of about 50,000 psi. Even higher strength can be obtained by adding 6% Ag or 10% Cd to Mg-20Sc. Further exploratory studies of Mg-Sc ternaries and a larger laboratory scale evaluation of Mg-30Sc and the most promising ternaries are recommended for future work. Author

N68-35200*# Norton Research Corp., Cambridge, Mass.
MECHANISM OF THE ATMOSPHERIC INTERACTION WITH THE FATIGUE OF METALS
M. J. Hordon and M. A. Wright Washington NASA Sep. 1968 54 p refs
(Contract NASw-1533)
(NASA-CR-1165) CFSTI: HC$3.00/MF$0.65 CSCL 11F

In an investigation of the fatigue properties of aluminum in vacuum, experimental work was directed at cyclic frequency and tensile fatigue effects, and at the defect substructure generated in vacuum by fatigue stressing. The mean fatigue life was observed to depend on the cyclic rate of straining at all pressure levels. However, in the region of the critical pressure zone for fatigue life enhancement, changes in the cyclic frequency were noted to have a major effect on crack propagation. Measurements of the fatigue life under conditions limited to alternating tensile stresses alone showed that fatigue life enhancement or crack growth retardation in vacuum was not dependent on compressive stress distributions or fatigue crack closure. Finally, a well defined correlation was observed between the fatigue properties of aluminum and dislocation substructural distributions revealed by thin film electron microscopy. Author

N68-35224*# Techtran Corp., Glen Burnie, Md.
CALCULATION OF THE THERMODYNAMIC PROPERTIES OF ALLOYS OF NICKEL AND COBALT [RASCHET TERMODINAMICHESKIKH SVOYSTV SPLAVOV NIKELYA I KOBAL'TA]
B. P. Burylev Washington NASA Sep. 1968 10 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Tsvet. Met. (Dzaudzhikau), v. 10, no. 4, 1967 p 35–39
(Contract NASw-1695)
(NASA-TT-F-11914) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The theory of regular solutions is applied to the problem of determining component activity, thermodynamic quantities, and heats of mixing of strongly interacting systems. Formulas are produced for calculation of thermodynamic and thermochemical properties of solutions consisting of components which form large negative and positive asymmetrical deflections from the law of ideal solutions. The intermolecular interaction constants are calculated for many alloys of nickel and cobalt with various elements, which can be used to estimate the concentration dependence of the activity of the components, the mixing heat and the area of existence of two immiscible phases. Author

N68-35243# Ballistic Research Labs., Aberdeen Proving Ground, Md.
QUASI-STATIC COMPRESSION STRESS-STRAIN CURVES FOR ANNEALED, COMMERCIALLY PURE ALUMINUM Memorandum Report
John H. Suckling and John T. Frasier Jun. 1968 28 p refs
(BRL-MR-1925; AD-673106)

By means of the von Karman-Taylor theory of plastic wave propagation predictions of dynamic behavior are made from averaged quasi-static curves for the purpose of providing a basis of comparison with data derived from impact tests. Author (TAB)

N68-35281# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF GASES IN METALS BY THE VACUUM FUSION METHOD
Chin-Tan Tsu 19 Sep. 1967 20 p refs Transl. into ENGLISH from Hua Hsueh Shih Chiel (Peking), v. 19, no. 10, 1965 p 461–465
(FTD-HT-67-286; AD-672912)

A review is given of the history, principles, operation, and advantages of the vacuum fusion process for the analysis of nitrogen, oxygen, and hydrogen in metals. Also, a new apparatus for this process is introduced. TAB

N68-35309 National Lending Library for Science and Technology, Boston Spa (England).
THE INFLUENCE OF FERRITE ON THE RESISTANCE TO CORROSION OF Cr–Ni STAINLESS STEELS
S. Henrikson 12 Aug. 1968 4 p Transl. into ENGLISH from Acciaio Inossidabile (Milan), v. 32, no. 1, 1965 p 122–123
(C.E.-TRANS-4801) Available from Natl. Lending Library, Boston Spa, Engl.

Mention is made of cases in which ferrite increases and impedes corrosion in Cr–Ni stainless steels. Potential current density is graphed for an austenitic stainless steel in sulfuric acid; and another graph indicates considerable difference in corrosion current between the austenite and ferrite is indicated in both the potential and transpassive zones. M.W.R.

N68-35313# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CORRELATION BETWEEN STRUCTURE AND SERVICE CONDITIONS OF A METAL [O KORRELYATSII MEZHDU STRUKTUROY I USLOVIYAMI SLUZHBY METALLA]
G. Ya. Kozyrskiy and G. A. Petrunin 30 Nov. 1967 11 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Fiz. Priroda Plast. Deformatsii (Kiev), 1966 p 49–55
(FTD-MT-24-331-67; AD-672708)

The investigation was carried out with pure nickel (99.99%). After their preparation, all the samples were annealed in vacuum at a temperature of 1100C for 4 hours. Tests were made of the creep of the annealed nickel samples and on samples which had been previously drawn out to an optimum degree of deformation. The previous deformation was done at room temperature at a rate of 0.4%/sec. Conditions of the creep test and the degree of previous deformation are shown in a table. Before the tests, the previously deformed samples were annealed for 1 hour at the experimental temperature. All samples were subjected to x-ray and metallographic analysis. The following conclusions were drawn: (1) a correlation was established between the substructure and the service conditions of a metal. It was shown that each working temperature corresponds to a particular substructure. Such corresponding substructures can be created by deformation and annealing; (2) the treatment of a metal depends on its service conditions; (3) one of the particular features of the substructure is that the higher the working temperature of the metal, the lower should be the latent energies of its sub-boundaries. Author (TAB)

N68-35323# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CORROSION OF CHROMIUM–NICKEL STAINLESS STEEL IN LITHIUM [KORROZIYA NERZHAVEYUSHCHEY KHROMONIKELEVOY STALI V LITII]

N. M. Beskorovaynyy, V. K. Ivanov, and V. V. Petrashko 13 Sep. 1967 12 p refs Transl. into ENGLISH from Inzh.-Fiz. Inst., Met. Metalloved. Chistykh Metallov (Moscow), no. 5, 1966 p 163–172 (FTD-MT-24-262-67; AD-672704)

Three series of 1Kh18N9T stainless-steel specimens were tested for corrosion behavior in lithium at 700C for 10 or 200 hr. Series 1 and 2 specimens were tested in lithium containing a small amount of C14 isotope and in tanks made of 1Kh18N9T steel (series 1) or Armco-iron (series 2). In the case of series 3 specimens, the lithium contained 0.1% carbon in addition to C14 and the tanks were made of Armco-iron. The corrosion was found to follow the same pattern under all the conditions tested, and characterized by a gradual dissolution of chromium and nickel from the surface layer of the specimens. With decreasing chromium and nickel content the steel changes its structure and gradually loses its corrosion resistance. Author (TAB)

N68-35380# Brown Univ., Providence, R. I.

EFFECT OF SURFACE CONDITION ON THE EXHAUSTION OF DUCTILITY BY COLD OR HOT STRAINING Progress Report

J. Dvorak and C. Mylonas Jul. 1968 46 p refs (Contract Nobs-88294) (PR-7; AD-672897)

The compressive prestrain (exhaustion limit) needed to cause brittle behavior in subsequent tension was found to be much higher in ABS-B steel bars with surfaces machined by about 0.030 in. before straining than with as-rolled surfaces, even more so when the surfaces were machined after straining. Removal of the strained surface caused a small increase of exhaustion limit even when the surfaces had been machined before prestraining. In all cases the increase was larger for bars prestrained at 550F than at 70F. The surface effect was found stronger than in earlier tests with an ABS-C steel. In addition the microhardness was found to rise gradually in a 0.030 in. layer adjacent to the surface and to reach a peak at the surface itself in all as-rolled or as-strained surfaces. The surface damage from an unfavorable rolling history permits an easier surface embrittlement by hot straining in a region of strain concentration close to a weld and creates a dangerous trigger of brittle fracture, as is indicated by service fractures starting at such regions. A study of the rolling and straining history causing such weak regions could help their prevention. Author (TAB)

N68-35417# Japan Atomic Energy Research Inst., Tokyo.

OXIDATION KINETICS AND OXIDE FILM BREAK-AWAY OF ZIRCONIUM AND ITS ALLOYS AT HIGH TEMPERATURES

Sueo Nomura and Cho Akutsu Jun. 1968 23 p refs (JAERI-1161) CFSTI: HC$3.00/MF$0.65

The oxidation of Zr, Zircaloy-2, and Zr binary alloys with Cu, Ni, Sn, and Nb was studied, with emphasis on the mechanism of the rate transition in 600° to 850°C dry oxygen. The results obtained from the continuous gravimetric measurements were compared with the oxide morphology involving hot-stage microscopy, X ray and electron diffraction data, and electron beam microprobe analysis of the oxide-metal interfaces. No close relationship was found between the rate transition and either cracking or transformation of the oxide. A mechanism involving the recrystallization of the oxide is discussed based on a consistent relationship between the kinetic behavior and the behavior of the alloying elements during the oxidation. Stability of anion vacancies in ZrO_2 was pointed out as an important factor determining the rate transition. Author

N68-35429# Boeing Co., Renton, Wash. Airplane Div.

PARTICLE SIZE LINE BROADENING RESULTING FROM Ti_3Al PRECIPITATION IN Ti–Al ALLOYS

Roy G. Baggerly 18 Apr. 1968 32 p refs (D6-23294; AD-672994)

The effect of temperature on growth of Ti3Al precipitates in Ti - Al Alloys was determined with sensitive X-ray diffraction techniques. It was found that the precipitate size in Ti-8.5% Al alloy was considerably more dependent on aging temperature than the precipitate size in 8-1-1 alloy. Also the solvus temperature for precipitation was approximately the same for the two alloys (675C to 700C). Author (TAB)

N68-35444# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION IN REGION OF FRICTIONAL MATERIALS [ISSLEDOVANIYA V OBLASTI FRIKTSIONNYKH MATERIALOV]

I. M. Fedorchenko , I. I. Panaioti, and G. M. Derkacheva Oct. 1967 10 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR, (Kiev), no. 5, 1965 p 54–57 (FTD-MT-24-238-67; AD-672695)

Powder-metallurgy Fe-P alloys contg. 0.7, 0.8, 0.9, and 1.0 wt. % P were prepared by pressing under 35-40 kilonewtons/sq cm and sintering in a protective atmosphere at 1080 plus or minus 10C for 1 hr., applying during sintering a pressure of 150-200 newtons/sq cm. Friction characteristics were determined by friction against dry cast iron with hardness of 1.2-1.5 kilonewtons/sq cm and comparing with similar results obtained with the powder-metallurgy material FMK-11 and asbestos-tar composition FK-16-L. Iron P powder-metallurgy alloys exhibit satisfactory friction coefficients and show wear resistance 3.5 and 20 times those of the materials FMK-11 and FK-16-L respectively. Author (TAB)

N68-35626*# Martin Co., Baltimore, Md. RIAS Div.

A FLOATING ZONE TECHNIQUE FOR THE GROWTH OF CARBIDE SINGLE CRYSTALS

Walter Precht and Graham E. Hollox May 1968 23 p refs /ts NASA TR-6; AROD TR-2 (Contracts NASw-1290; DA-31-124-ARO(D)-467) (NASA-CR-97008; RIAS-TR-68-9c; AD-677639) CSCL 11B

Single crystals of pure and alloyed carbides of different carbon-to-metal ratio have been prepared using a floating zone technique. This paper discusses application of this technique specifically to the growth of VC single crystals. Longitudinal variations in composition from about VCO .82 to VCO .75 are observed when a rod of initial uniform composition VCO .75 is zone refined. Variations in composition from about VCO .85 to VCO .88 are produced in rods initially of composition VCO .88. However, since VCO .83 is close to the melting-point maximum in the VC phase, little variation in composition is observed on zone refining. These variations in composition are as expected from considerations of the phase diagram and the principles of zone refining. The production of rods of constant composition utilizing the principles of zone levelling is discussed. Author (TAB)

N68-35652*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE NONDESTRUCTIVE EVALUATION OF STRESS-CORROSION INDUCED PROPERTY CHANGES IN ALUMINUM

W. N. Clotfelter, B. F. Bankston, and E. E. Zachary 23 Aug. 1968 44 p refs (NASA-TM-X-53772) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Experiments were designed to investigate methods by which potential stress corrosion failures could be evaluated during the period of incubation. These experiments involved precise measurements of selected physical property changes in the material during the onset of stress corrosion. Both highly susceptible and highly resistant materials were included in the experimental program.

The resultant data show clearly that the period of stress corrosion incubation can be detected nondestructively in the highly susceptible alloys. Author

N68-35657# Pennsylvania State Univ., University Park.
THE ELASTIC CONSTANTS OF POLYCRYSTALLINE $HoZn_2$
D. J. Michel, Earl Ryba, and Z. P. Chang 23 May 1968 8 p refs
(Contract AT(30-1)-3560)
(NYO-3560-12) CFSTI: HC $3.00/MF $0.65

The elastic constants of polycrystalline $HoZn_2$ were determined in the 90 to 298°K region by ultrasonic techniques. The constants $C_{11} = \rho V^2_L$ and $C_{44} = \rho V^2_S$ vary with temperature in linear manner and were extrapolated to 0°K by a least-squares fit to the data to give 1.176×10^{12} and 0.334×10^{12} dynes/cm², respectively. The Debye Temperature for $HoZn_2$ was calculated to be 247°K, and the bulk modulus of $HoZn_2$ at 298°K is 0.6814 $\times 10^{12}$ dynes/cm². Author (NSA)

N68-35678# California Univ., Livermore. Lawrence Radiation Lab.
THE DIFFUSION OF IRON IN VARIOUS FERROUS ALLOYS
D. Y. F. Lai and R. J. Borg 1 Sep. 1967 6 p refs
(UCRL-50314) CFSTI: HC $3.00/MF $0.65

The effect of various solutes upon the self diffusion of Fe was measured using a sectioning technique with ^{59}Fe as a tracer. Autoradiographs taken at various depths during the sectioning established absence of severe grain boundary diffusion. All alloys except Fe–V and Fe–Al exhibit extreme intergranular fracture which was eliminated by hot rolling and reannealing. Results of diffusion measurements for Fe in Al, Ge, Si, Sm, Sb, Sn, Ti, and V are tabulated. NSA

N68-35724# Argonne National Lab., Ill.
STRESS RUPTURE AND CREEP BEHAVIOR OF AUSTENITIC Cr–Ni STEELS IN THE PRESENCE OF Na [UBER DAS ZEITSTAND- UND KRIECHVERHALTEN VON AUSTENITISCHEN CHROM–NICKEL–STAHLEN IN GEGENWART VON NATRUM]
H. Boehm and H. Schneider [1967] 14 p refs Transl. into ENGLISH from J. Nucl. Mater. (Netherlands), no. 24, 1967 p 188–197
(ANL-TRANS-594) CFSTI: HC $3.00/MF $0.65

A study was made on the influence of liquid sodium on the creep- and stress-rupture properties of two austenitic steels at 700°C. The tests were carried out on sodium filled tubes of X8CrNiMoVNb 1613 and Incoloy 800 under uniaxial stress. Author (NSA)

N68-35801# Army Weapons Command, Rock Island, Ill. Research and Engineering Div.
THE EFFECT OF SMALL ADDITIONS OF SILVER ON THE MECHANICAL PROPERTIES OF ALUMINUM CASTING ALLOYS
R. B. Miclot May 1968 30 p refs
(RIA-68-1320; AD-672751)

The report presents significant test results showing that 0.3% silver additions to melts of certain aluminum casting alloys, 40E and Precedent 71A, increase the yield and tensile strengths without large loss of ductility. Yield strength improves 80% and tensile strength 45% in test-size castings of silver treated 40E alloy, after solution-precipitation treatment; yield and tensile strengths increase more than 13% each, in machined specimens from end-chilled plates. A one week delay between solution treatment and artificial aging of the standard 40E alloy improves the yield and tensile strengths more than 30% each, but no additional improvement occurs in the silver-treated alloy. After artificial aging only, test-size castings from the silver treated alloy increase more than 25% in yield and 10% in tensile strength; machined specimens from plates improve more than 15% in yield and 5% in tensile strength. Only marginal gain in yield strength occurs after natural aging for 40 days. Remelting of the alloy does not destroy the beneficial effects of silver additions. Silver improves the yield strength 5 to 10% in Precedent 71A alloy after solution-precipitation treatment. Author (TAB)

N68-35869# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE STRAIN AGING OF OXYGEN IN MOLYBDENUM
Ying-Lieng Ma and Tsu-Yi Sung Sep. 1967 17 p refs Transl. into ENGLISH from Chin Shu Hsueh Pao (Peking), v. 8, no. 3, 1965 p 332–338
(FTD-HT-67-206; AD-673650)

The report discusses investigations which have been carried out to study the process of strain ageing caused by oxygen in molybdenum by measuring the variation of the height of the internal friction peak with ageing time. It was found that the peak height decreases gradually and eventually disappears with ageing-time both in quench-aged and in strain-aged specimens. Systematic studies have been made on the kinetics of strain ageing and on the effect of deformation on the peak height. According to experimental results, it is believed that the decrease of the peak height is associated with the segregation of oxygen atoms to dislocations during ageing. On the basis of the assumption, the dislocation density and the atmosphere concentration were estimated. Author (TAB)

N68-35908# Los Alamos Scientific Lab., N. Mex.
CHARACTERIZATION OF COMMERCIAL REFRACTORY METAL AND METAL CARBIDE POWDERS
R. E. Riley and J. E. Magnuson 6 Jun. 1968 22 p ref
(Contract W-7405-eng-36)
(LA-3894) CFSTI: HC $3.00/MF $0.65

A variety of morphological types of structures are obtainable as a result of the manufacturing processes employed and more than one type of structure can result from the same manufacturing process. Four basic morphological types of structures have been identified for the powders examined, and their influence on final properties have been evaluated. The development work described resulted in a breakthrough for better understanding of the practical application of powder characterization data. Significant to this work is the fact that, with the aid of morphology, a procurement specification for a powder to meet a particular requirement can be established. Author (NSA)

N68-35932# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTIWEAR PROPERTIES OF STEEL IN THE PRESENCE OF POLYMER POWDERS [PROTIVOIZNOSNYE SVOISTVA STALI V PRISUTSTVII POROSHKOV POLIMEROV]
G. V. Vinogradov, Yu. Ya. Podol'skiy and V. A. Mustafaev 4 Oct. 1967 13 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Inst. Mashinovedeniya Trenie i Iznos v Mashinakh (Sbornik), no. 19, 1964 p 127–137
(FTD-HT-23-502-67; AD-673790)

The behavior of powders of the following polymers was studied in friction tests on steel balls: polymethyl methacrylate, polypropylene, polyethylene (with various contents of CH3 groups), polyvinyl butyral, polystyrene, polyformaldehyde, polytetrafluoroethylene, polyvinyl chloride, polyvinylidene chloride, polyvinyldimethylphenylsilane, polyvinylmethylphenylsilane, and polyallyltrimethylsilane. Under severe friction conditions (high loads and slip velocities), the antifriction and antiwear properties of the powdered polymers are determined by a combination of the rheological properties of the polymers and their capacity to modify

steel surfaces chemically. Remarkable antiwear properties over the entire range of loads studied were displayed by powders of polypropylene and polyethylene with a maximum degree of branching, and also by polytetrafluoroethylene. The optimum antiwear properties are exhibited by polymers which are sufficiently stable at low temperatures, but are capable of performing the functions of oxygen suppliers and other agents that modify the metal surfaces at high temperatures. Author (TAB)

N68-35969# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATIONS OF ALUMINUM ALLOYS IN BUILDING STRUCTURES (SELECTED SECTIONS) [PRIMENIYE ALYUMINIYEVYKH SPLAVOV V STROITEL'NYKH KONSTRUKSIYAKH]
T. N. Morachevskiy 18 Sep. 1967 32 p ref Transl. into ENGLISH from Akad. Stroitel'stva i Arkhitektvry SSSR (Moscow), 1959 p 11–48
(FTD-HT-67-346; AD-673801)

The classification, chemical composition and mechanical characteristics of aluminum alloys produced in the USSR are presented in this report. Aluminum alloys are divided into two categories - casting and shaping. Casting alloys are used for making various intricately shaped castings, and their chemical composition is divided into five groups. GOST 2685-53 lists the chemical composition and mechanical properties of casting alloys. Author (TAB)

N68-36001*# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A STUDY OF TUNGSTEN–TECHNETIUM ALLOYS Concluding Progress Report, 1 Oct. 1966–1 Aug. 1968
R. G. Nelson and D. P. O'Keefe Sep. 1968 66 p refs
(NASA Order R-48-005-001; Contract AT(45-1)-1830)
(NASA-CR-17099; BNWL-865) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Experiments were conducted to recover technetium from fission product wastes, reduce it to purified metal, and prepare W–Tc alloys containing up to 50 at.% Tc. Forged alloys were hot-rolled to 0.050 in. sheets and cut into bend test specimens. The compositions for producing successful sheet are given, and the microstructures depicted show that extremely large recrystallized grain structure is typical for all compositions. In the recrystallized W–Tc alloys, it appears that compositions of 3.5 and 20 at.% are most effective in lowering bend transition temperature. Tabulated data are presented on the cold breakdown forging, intermediate cold-rolling, and final recrystallization of electron-beam-melted pure Tc; and on the hot breakdown rolling, intermediate cold-rolling, final cold-rolling, and final recrystallization of arc-melted pure Tc. The tensile strength of 45% cold-rolled Tc was found to be 219,000 psi; the 0.2% offset yield strength is 187,000 psi with an elongation of 4% and a Young's modulus of 40.9 $\times$ 10^6 psi. M.G.J.

N68-36004*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
INVESTIGATION OF THE REINFORCEMENT OF DUCTILE METALS WITH STRONG, HIGH MODULUS DISCONTINUOUS, BRITTLE FIBERS Quarterly Report, 1 May–1 Aug. 1968
A. Gatti, J. M. Berry, and J. V. Mullin 1 Aug. 1968 31 p refs
(Contract NASw-1543)
(NASA-CR-96350; Rept.-2410-2E2; QR-7) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The critical factors affecting the reinforcement of ductile metals with short, brittle fibers were investigated. The study covered Al or Al alloys and ductile epoxies, reinforced with whiskers or high modulus filaments. The whiskers and filaments differed somewhat in composition, but they consisted basically of boron with a W substrate core and with B_4 vapor deposited over it. Other filaments had a SiC deposit on the W substrate core. Strength characteristics were determined by tensile tests. Maximum strength values were near 590,000 psi, minimum values near 18,000 psi. Tensile tests with the same specimens were also attempted at 500°C. A number of aluminum specimens containing single, five-filament, and ten-filament arrays were fabricated by a hot pressing technique and tested at room temperature for tensile strength as a function of strain rate and filament matrix bonding. A qualitative discussion of the relationship between bond strength and composite strength is included. It is shown that when a volume fraction of filaments becomes large enough to cause a critical spacing, the strength of the composite will begin to decrease even though the volume fraction of filaments is increased. K.W.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-34885 Case Inst. of Tech., Cleveland, Ohio.
LAMELLAR STRUCTURE AND MELTING OF POLYOXYMETHYLENE
David Randolf Carter (Ph.D. Thesis) 1967 162 p
Available from Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 67-16065

Lamellar structure and melting behavior were investigated with DTA, low angle X-ray diffraction, and electron microscopy for polyoxymethylene crystallized isothermally from the melt and from dilute solution. Single crystals precipitated from dilute solution exhibited one X-ray long period, L, but two DTA endotherms, T_1 and T_2. The low temperature endotherm, T_1, was linear with L^{-1}, from which were calculated σ_e = 51 erg/cm^2 and an equilibrium value of T°_1 = 187°C. Good agreement exists between these values and those in the literature for homogeneous nucleation, single crystal dissolution, and other data. T_2 remained relatively constant and represented the melting of material formed, during heating, from the original single crystals. Melt-crystallized POM produced intense and weak sets of DTA and low angle X-ray data. The weak data yielded $T_m(w)$ = 182°C and $\sigma_e(w)$ = 37 erg/cm^2, similar to the single crystal values. Various correlations, including a new method which allows a determination of σ, were applied to the intense bulk data. The calculations produced $T^\circ_m(s)$ = 211°C, $\sigma_e(s)$ = 150 erg/cm^2, and σ = 14 erg/cm^2, all of which are considerably larger than published values or the values of the single crystal. They are consistent, however, with the present data and a kinetic theory analysis of spherulitic growth rates. Dissert. Abstr.

N68-35100*# Astro Research Corp., Santa Barbara, Calif.
AN EVALUATION OF BORON-POLYMER FILM LAYER COMPOSITES FOR HIGH-PERFORMANCE STRUCTURES
R. F. Crawford Washington NASA Sep. 1968 40 p refs
(Contract NAS7-427)
(NASA-CR-1114; ARC-R-276) CFSTI: HC $3.00/MF $0.65 CSCL 11I

A composite film of polyimide with boron vacuum-deposited on one side has become available for development as a structural material. The objective of the present investigation has been to evaluate the fabricability, mechanical properties, and structural efficiency potentials of this material for structural composites. Hollow

tubular test specimens were readily fabricated by wrapping the composite film over mandrels and bonding layers together with epoxy adhesive. These specimens were then tested under axial and bending loads to determine their stiffness and strength. The most important attribute of this form of composite material is that it is bidirectional, in contrast to filaments, which are unidirectional. Structural efficiency analyses performed in this investigation showed that the potential weight savings offered by this bidirectional attribute can be significant for applications such as facings for sandwich cylinders and plates subjected to inplane compression, where biaxial stiffness benefits structural stability. Author

N68-35188*# Huyck Metals Company, Milford, Conn.
INVESTIGATION OF THE PROPERTIES OF FIBER METAL ACOUSTICAL MATERIALS
J. J. Cimerol, A. R. Erickson, and J. I. Fisher Sep. 1968 177 p refs
(Contract NAS1-6990)
(NASA-CR-66643) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Twenty-eight alternative fiber metal acoustical materials were evaluated in environmental tests under conditions simulating those expected to be encountered in the silencing of turbofan jet engines. The program simulated a number of environmental conditions to which the materials may be exposed in service. Detailed mechanical and physical property information was obtained, and the effects of air erosion, water saturation and freezing, fuel combustion, high temperatures, and salt spray corrosion were measured. Tests were performed to assess the relative ease with which the materials could be cleaned of dust and soot contamination. In general, at least type 347 stainless steel fiber metal materials were considered to have passed all of the tests imposed. Author

N68-35211 National Lending Library for Science and Technology, Boston Spa (England).
THE DIELECTRIC STRENGTH OF EPOXY RESINS IN DEPENDENCE ON TEMPERATURE AND MECHANICAL STRESSES
R. Schmid 12 Aug. 1968 7 p refs Transl. into ENGLISH from Kunststoffe (Solothurn), v. 57, Sep. 1967 p 711–714
(C.E.-TRANS-4773) Available from Natl. Lending Library, Boston Spa, Engl.

The electric strength of epoxy resins is dependent on the temperature and mechanical stresses. The voltage-time behaviour is particularly strongly influenced by these two factors. Interesting relationships have been found between the chemical structure, mobility of the polar groups and the electric strength. Surprisingly large differences are found between the different resin/hardener systems. In view of the applications of epoxy resins in the high voltage field, the selection of resin/hardener systems, as well as design precautions, assumes outstanding importance. F.S.

N68-35267 National Lending Library for Science and Technology, Boston Spa (England).
STUDY OF THE STRUCTURAL VARIATIONS LEADING TO DEVITRIFICATION, BY MEANS OF LIGHT SCATTERING
L. Prod'Homme and C. Vacherand 5 Sep. 1968 15 p refs Transl. into ENGLISH from Verres Refractaires (Paris), v. 20, no. 5, Sep.–Oct. 1966 p 354–361
(TRANS-2496) Available from Natl. Lending Library, Boston Spa, Engl.

Variations in light scattering intensities were used in this study of glasses subjected to temperatures at which the reduction in viscosity begins to permit certain structural modifications to occur. Two types of glasses were studied: (1) classical optical glasses: a potassium borosilicate and a light flint; and (2) a sodium borosilicate glass exhibiting a very faint opalescence, and glasses obtained from it by adding various opacifiers. It was found that in optical glasses noted for their high resistance to devitrification, thermal treatment at temperatures in the transformation region causes discrete molecular aggregation phenomena. In glasses which show a natural tendency to phase segregation, the different degrees of opalescence caused by the addition of foreign cations show that these latter only have the role of a catalyst for the mechanism forming the nuclei. Author

N68-35270# Dayton Univ., Ohio. Research Inst.
ELECTRICAL AND LUMINESCENT EFFECTS OF FRACTURE IN SOME FIBER REINFORCED PLASTICS Technical Report, Oct. 1967–Feb. 1968
William Mahieu May 1968 41 p refs
(Contract AF 33(615)-3512)
(AFML-TR-68-113; AD-672998)

Structural fiber reinforced plastics under applied stress exhibit an internal microcracking process that often begins at small fractions of the ultimate strength of these materials and with increasing load complete fracture of a specimen occurs. This process is a complex combination of fiber fracture, small cracks in the matrix phase and fiber-matrix interfacial debonding, depending on the stress level, materials involved and other factors. There is a current need for additional means of detecting and measuring this process as it occurs. The report presents experimental evidence that such microcracking in these materials produces measurable electrical effects and in some cases the emission of visible light. Detection and measurement of these effects may provide new experimental tools for the investigation of the microcracking process in fiber reinforced plastics. Author (TAB)

N68-35280# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-TEMPERATURE REFRACTORY MATERIALS BASED ON ZIRCONIA STABILIZED BY RARE-EARTH OXIDES [VYSOKOOGNEUPORNYYE MATERIALY NA OSNOVE DVUOKISI TSIRKONIYA, STABILIZIROVANNOY OKISLAMI REDKOZEMEL'NYKH METALLOV]
N. Ye. Kind and L. T. Koshur 13 Sep. 1967 12 p refs Transl. into ENGLISH from Ogeneupory (Moscow), no. 10, 1966 p 55–58
(FTD-HT-67-300; AD-673211)

Zirconia specimens made with the addition of 11% (mol.) of CeO2 exhibit small thermal expansion and the high thermal stability. Increasing the amount of stabilizing cerium dioxide additive further, to 15 and 28% (mol.), lowers the thermal properties of the mixes. Yttrium oxide can also be used as a stabilizing additive to zirconium dioxide. Welts appeared on specimens made from these mixes after 11 heat cycles, and they failed at the 25th heat cycle. The highest thermal stability was found in those mixes in which the zirconium dioxide was represented after stabilization not only by the cubic, but also by the monoclinic modification. A secondary additive of monoclinic ZrO2 also improves the properties of specimens. A recipe and method for preparation of refractory products from zirconium dioxide are proposed. Author (TAB)

N68-35282# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTION OF LASER BEAM ON PLEXIGLAS [DEYSTVIYE SVETOVOGO DUCHA LAZERA NA ORGANICHESKOYE STKKLO]
A. I. Akimov, L. I. Mirkin, and N. F. Pilipetskiy 20 Sep. 1967 13 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekh. Fiz. (Moscow), no. 6, 1966 p 14–18
(FTD-MT-24-214-67; AD-672690)

A Q-switched laser and a controlled output power was used in a study of the effect of laser radiation on plexiglas. Destruction was manifested by the formation of microfractures or by the appearance of plane fractures. The type of destruction depended only on the focusing distance of the lens and not on the

power of the light beam. The destruction zone had a conical form and consisted of separated dots which dispersed light. The dots concentrated at the beam entrance and near the focal point. With a decrease in focusing distance, the number of microfractures diminished and the amount of large fractures increased. Author (TAB)

N68-35339# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Chemistry.
MORPHOLOGY AND GROWTH OF EXTENDED CHAIN CRYSTALS OF POLYETHYLENE
Bernhard Wunderlich and Louis Melillo Jul. 1968 30 p refs
(Contract Nonr-591(19))
(TR-15; AD-672839)

The morphology and growth of extended chain crystals of polyethylene is discussed on the basis of optical and electron microscopy. The spherulitic habit is shown to be caused by nucleation of new lamellae on the (001) surface of lamellae, branching of lamellae on their growth face, and thickening of lamellae. Spherulite centers have been identified down to the primary lamella. Analysis of intersections of lamellae during crystallization allowed the identification of intermediate stages of crystal growth. Fracture surfaces parallel to the growth face and the (001) face are discussed. Ripple decoration by surface recrystallization is developed as a tool for fracture surface study. Kink bands are described as growth defects. Bending of lamellae is shown to go by slip parallel to the polymer chains. Ripple and drawn out fiber annealing is analyzed. All observations on extended chain crystals are used to propose a mechanism of extended chain crystal growth of polyethylene under elevated pressure. Author (TAB)

N68-35348# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LARGER-DIMENSIONED ZIRCONIUM DIOXIDE ARTICLES WITH ELEVATED THERMAL STABILITY [BOL'SHEMERNYYE IZDELIVA POVYSHENNOY TERMICHESKOY STOYKOSTI IZ DVUOKISI TSIRKONIYA]
O. M. Margulis, I. F. Usatikov, and A. B. Kamenetskiy 13 Sep. 1967 13 p refs Transl. into ENGLISH from Ogneupory (Moscow), no. 2, 1964 p 63–67
(FTD-HT-67-301; AD-673227)

It was previously established that the thermal stability of refractory materials made of zirconium dioxide increased if certain amounts of isometric and monoclinic ZrO2 were melted and mixed together. The present work was carried out in order to determine the optimal quantities of the monoclinal part and the optimal grain sizes of both parts. The experiments showed that: (1) thermal stability of large items of zirconium dioxide increased with the use of 0 to 60 micron fraction of isometric ZrO2; (2) the monoclinic zirconium (introduced in insignificant quantities) gave best results when its grain sizes were smaller than 2 microns but even with 60-micron grains its thermal stability and the deformation temperature under load remained satisfactory; (3) 15% of coarse monoclinic zirconium gave the best results (the increase of its content from 15 to 25% lowered the strength of the material at room temperature); (4) thermal stability of large items made of zirconium dioxide was affected by the shape and the size of the item; (5) the introduction of the monclinic zirconium considerably increased the thermal stability of large items in comparison to those made only of isometric ZrO2. Author (TAB)

N68-35353# IIT Research Inst., Chicago, Ill.
ANALYSIS AND REVIEW OF MECHANICAL TESTING PROCEDURES FOR BRITTLE MATERIALS Final Report, Mar. 1967–Feb. 1968
Seymour A. Bortz and Kenneth T. Burton Jul. 1968 105 p refs
(Contract DA-19-066-AMC-321(X))
(AMRA-CR-67-09-F; AD-673145)

The purpose of this research is to provide a guide for investigators in the performance of mechanical tests and the interpretation of test results. A review of the philosophy of testing and the problem areas in studying brittle materials is provided. Research effort consists of investigating mechanical test procedures and analyzing property data with regard to these test procedures, so that the best practice can be determined. Evaluated information is organized into three sections: (1) Test philosophy, test techniques and analytical methods; (2) Correlation of laboratory tests and recommended procedures; (3) Tabular presentation of test data. TAB

N68-35381# Massachusetts Univ., Amherst. Polymer Research Inst.
RHEO-OPTICS OF HIGH SPEED DEFORMATION: 2. POLYETHYLENE AND POLYBUTENE-1
Peter F. Erhardt and Richard S. Stein Jul. 1968 21 p refs
(Contract Nonr-3357(01))
(ONR-TR-109; AD-672902)

The photographic light scattering technique was used to study the relationship between sample deformation and spherulite deformation during rapid stretching of polyethylene and polybutene-1 films. Scattering patterns are interpreted in terms of spherulite deformation theory to give the elongation ratio of the spherulite which is compared with that of the sample. At low elongations spherulite deformation is less than or equal to that of the sample indicating that an affine deformation model is a reasonable approximation. At high elongations the spherulite elongation ratio is greater than that of the sample. This is due to inhomogeneous deformation where the local deformation of the sample in the scattering region is greater than the macroscopic deformation. Author (TAB)

N68-35398# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
CHARACTERIZATION OF FUSED SILICA SLIPS Special Technical Report, 17 Dec. 1966–16 Dec. 1967
C. A. Murphy Apr. 1968 34 p refs
(Contract N00017-67-C-0053)
(GIT-A-994-2; AD-672921)

Commercial fused silica slips were evaluated according to a set of characterization parameters which were formulated to provide a basis for selection of fused silica slips for the fabrication of test radomes. This work on the characterization of the commercial fused silica slips is presented as a special report to furnish users and potential users of fused silica slip with a source for preparing engineering specifications and/or for making comparisons to data generated during the course of laboratory investigations or hardware fabrication programs. Author (TAB)

N68-35517 National Lending Library for Science and Technology, Boston Spa (England).
BIAXIAL PENETRATION TESTS ON IMPACT-RESISTANT PVC FILMS
M. Herner and W. Retting 24 Jul. 1968 7 p Transl. into ENGLISH from Kunststoff-Rundschau (Hamburg), v. 14, no. 10, Oct. 1967 p 473–477
(RAPRA-TRANS-1521/3) Available from Natl. Lending Library, Boston Spa, Engl.: £ 4

This method has shown itself of value in the development and testing of plastic films, and extensive use of it during the development of a transparent impact-resistant PVC film is reported. The procedure and apparatus are described, and results of a systematic variation in several parameters are given in 10

graphs. These show the relation between puncture resistance and temperature for various plasticizer contents from 0% to 20% and of four types, PVC with K-values of 65, 70, and 78, and for films with or without subsequent biaxial stretching. Author

N68-35519 National Lending Library for Science and Technology, Boston Spa (England).
ORIGIN AND PROPAGATION OF TEARS IN PLASTICS FILMS
N. A. Brunt Mar. 1968 17 p refs Transl. into ENGLISH from Plastica (Schiedam), v. 20, no. 7, Jul. 1967 p 275–285
(TRANS-1531)

The growth of a tear consists of the transition from a Griffith crack into a wedge with a sharp angle. The stress distribution has a discontinuity in the vertex of the wedge, making the rate of deformation high in a small region in the immediate environment of the tear tip. In viscoelastic materials high deformation rates are always connected with high elastic moduli, which explains how the large forces necessary for tearing can arise. It is argued that the concept of a critical breaking strength can be defined only for glass-like substances, but loses its meaning for viscoelastic materials where all parameters determining the mechanical behaviour are time-dependent. Author

N68-35525 National Lending Library for Science and Technology, Boston Spa (England).
EXAMINING ABS PLASTICS WITH THE ELECTRON MICROSCOPE
Koichi Kato Mar. 1968 10 p refs Transl. into ENGLISH from Kolloid-Z. (Darmstadt), v. 220, no. 1, Sep. 1967 p 24–31
(TRANS-1536)

For a long time osmium tetroxide has played an important part in electron-microscopy in the biological-medicinal field as a fixing and colouring agent. The author has been successful in applying the same reactant to synthetic polymer systems; osmium tetroxide is a suitable fixing and contrasting agent for showing the structure of ABS and similar synthetics, reinforced with rubber. The microtechniques developed for examining ABS materials and the results obtained are discussed with a view to their further application. Author

N68-35526 National Lending Library for Science and Technology, Boston Spa (England).
STRUCTURE OF PTFE
B. Heise, H. G. Kilian, and F. H. Mueller [1968] 39 p refs Transl. into ENGLISH from Kolloid-Z. (Darmstadt), v. 213, no. 1–2, Oct. 1966 p 12–17 Presented at Ger. Phys. Soc., Phys. of High Polymers, Mainz, 14 Apr. 1966
(TRANS-1535) Available from Natl. Lending Library, Engl. $50.00 or 20£

Structural changes in PTFE caused by various types of heat treatment and by cold stretching were investigated. Variations caused by heat treatment gave information on the fine- and super-structure whereas studies of the effect of stretching yielded additional information on the processes of plastic deformation in partially crystallised PTFE. Wide angle and small angle X-ray methods as well as a calorimeter method were used. Author

N68-35527 National Lending Library for Science and Technology, Boston Spa (England).
DIFFUSION AND PERMEATION OF GASES IN HIGH POLYMERS DEPENDING ON THE DEGREE OF CRYSTALLISATION AND TEMPERATURE
D. Jesshke and H. A. Stuart [1968] 13 p refs Transl. into ENGLISH from Z. Naturforsch. (Tubingen), v. 16A, 1961 p 37–50
(TRANS-1537) Available from Natl. Lending Library, Boston Spa, Engl. $22.00 or 9£

The permeation, diffusion, and solubility coefficients of amorphous and crystalline polypropylene and a polyester resin to helium, water vapour, hydrogen, nitrogen, and carbon dioxide were determined. These coefficients are lower for the crystalline polymers and are a function of the kind of gas and the temperature. The results are discussed and shown graphically with experimental details and diagrams of the apparatus. Author

N68-35589*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROTON AND ULTRA-VIOLET IRRADIATION OF THE TARGET SPHERE MATERIAL ON RAE-A IN A SYSTEM ALLOWING FOR IN-SITU OPTICAL MEASUREMENT
C. A. Nicoletta Aug. 1968 21 p
(NASA-TM-X-63354; X-713-68-362) CFSTI: HC $3.00/MF $0.65
CSCL 11D

One-inch diameter, diffuse samples of the Radio Astronomy Explorer-A (RAE-A) target material, zinc titanate over lexan, were exposed to low energy protons and also to low energy protons and ultraviolet radiation sequentially. A system was designed and assembled with available components to carry out the test in-situ. Degradation was monitored by the percent change in the total solar absorptance (0.3-2.4)μ, as obtained from optical reflectance measurements of the sample compared to an MgO reference. Very little degradation was seen for total proton fluxes below 10^{15} protons/cm^2 at both 10 Kev and 15 Kev. Above 10^{15} protons/cm^2, the change in solar absorptance increased rapidly, being greater for the 15 Kev beam. Degradation was enhanced by both protons and UV at first, with a leveling off at higher total proton fluxes, depending on the equivalent sun hours of UV irradiation received. Author

N68-35611#
ON THE INFLUENCE OF THE INITIAL TEMPERATURE ON THE RATE OF MASS ENTRAINMENT OF HEAT-SHIELD COKING MATERIALS
A. M. Vinitskii, V. I. Demidov, and E. A. Chudetskaia [1967] 3 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostro (Moscow), no. 5, 1968 p 78–80
CFSTI: HC $3.00/MF $0.65

Initial temperature effects on the behavior of heat shield materials consisting of silicon dioxide fibers and phenol-formaldehyde resins are studied by observation of sample size changes and duration of linear mass entrainment. Experiments show that the lower the initial temperature of the tested sample the longer is the time of the beginning mass entrainment. G.G.

N68-35675 National Lending Library for Science and Technology, Boston Spa (England).
VULCANISATION OF BUTADIENE/NITRILE RUBBERS WITH SULPHUR DIOXIDE AND HYDROGEN SULPHIDE
A. F. Nosnikov and G. A. Blockh [1968] 5 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Khim. i Khim. Tekhnol. (Moscow), v. 9, no. 6, 1966 p 959–963 *Its* Commun. No. 2
(TRANS-1528) Available from Natl. Lending Library, Boston Spa, Engl. $8.00 or 3£

Experiments were conducted on producing molded rubber articles, based on the vulcanization of butadiene–nitrile rubbers, by means of introducing hydrogen sulfide and sulfur dioxide on zeolites. It was established: (1) This technique makes it possible to produce substantial vulcanized articles based on butadiene and butadiene–acrylonitrile rubbers. (2) Unfilled rubbers obtained by vulcanization with hydrogen sulfide and sulfur dioxide are superior to unfilled sulfur vulcanizates in mechanical properties and resistance to heat aging. Author

N68-35712# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe.

INVESTIGATIONS ON URANIUM NITRIDES AND CARBONITRIDES [UNTERSUCHUNGEN AN URANNITRIDEN UND CARBONITRIDEN]

A. Naoumidis Mar. 1967 98 p refs

(JUL-472-RW; RNL-TR-1918) CFSTI: HC $3.00/MF $0.65

Investigations were carried out on the U–N system, on mixed-crystal formation of UN with UC, and on the hypothetical UO system. The following systems were studied: the single phase region U_2N_2–UN_2, the formation of the β phase of U_2N_3, and the UN–UC–UO system. The various phases were prepared and investigated by X-rays and metallographically. N equilibrium pressures of these phases were measured as a function of temperature and composition. From these measurements the thermodynamic magnitudes ΔG, ΔH, and ΔS of the formation of the various phases were calculated. The composition of the compounds prepared was determined by a modified N_2 analysis. Author (NSA)

N68-35759# Mound Lab., Miamisburg, Ohio.

QUICK-CURING FOAM SYSTEMS

L. W. Hartzel, L. E. Brown, J. D. Nutter, and E. G. Thomas 15 Jul. 1968 74 p refs

(Contract AT(33-1)-GEN-53)

(MLM-1397; UCRL-13277) CFSTI: HC $3.00/MF $0.65

Many formulations prepared from commercially available materials were briefly scanned in order to develop a rapid-curing foam system that would yield a satisfactory product at room temperature. The most promising of these systems were evaluated for reactivity over the temperature range from −60 to 80° C, foaming ability, and solvent resistance of the end product. Simultaneously, studies were made on the stability of components of these formulations when subjected to storage at 110°C. The effect of this aging on viscosity, refractive index, heat of reaction, and foaming ability was determined. On the basis of the above-mentioned tests, formulations were continually modified to improve their properties. The effect of the incorporation of flexible modifiers and silicone surfactants into epoxy foam formulations was investigated. Author (NSA)

N68-35808# Technische Hogeschule, Delft (Netherlands). Afdeling der Werktuigbouwkunde.

THERMO ELASTIC EFFECTS IN RUBBER

J. F. Besseling and H. H. Voetman Apr. 1968 23 p refs

(WTHD-1; Rept.-378) CFSTI: HC $3.00/MF $0.65

Constitutive equations for the mechanical behaviour of rubber have received much attention in large deformation theory, and especially the Mooney-Rivlin theory for incompressible material has been studied very much. On the other hand there exists a vast literature on the general physical properties of rubber and in particular some striking thermoelastic effects have been revealed. For a description of these phenomena it is necessary to drop the simplifying hypothesis of incompressibility. It is shown that the thermo-elastic effects may be adequately described by an internal energy function, which in a purely mechanical sense entails only a small modification of the Mooney-Rivlin strain-energy function. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-34867 Columbia Univ., New York.

A MATRIX APPROACH TO PROGRAM DESCRIPTION AND OPTIMIZATION

Robert Loyd Basford (Ph.D. Thesis) 1967 183 p

Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-14022

A method of program optimization based on considering any program as a set of functions relating initial and final variable values is developed. A matrix-like program notation is introduced which possesses many of the properties of the ordinary matrix calculus. In particular if matrices A and B represent simple program segments, then the concatenation of the program segments may be represented by the matrix BA. Using this matrix notation for optimizing programs which contain no loops or branches is described. The result is shown to be unique and optimum in a certain sense. Finally, the notation scheme is extended to include programs with branches, and an algorithm is presented which appears to produce a near-optimum form for a program containing a single loop. Dissert. Abstr.

N68-34878 California Univ., Los Angeles.

CONSTRAINT THEORY APPLIED TO MATHEMATICAL MODEL CONSISTENCY AND COMPUTATIONAL ALLOWABILITY

George Jerry Friedman (Ph.D. Thesis) 1967 345 p

Available from Univ. Microfilms: HC $15.55/Microfilm $4.45 Order No. 67-16012

This dissertation develops an analytic foundation for the determination of whether a mathematical model and its desired computations are "well-posed" It is anticipated that the systematic procedures developed will help alleviate the software problems associated with the simulation of complex, large scale systems by heterogeneous mathematical models involving several hundred dimensions. The problem is approached by providing a rigorous basis for the rather commonplace notion of "constraint." Four distinct viewpoints of the mathematical model are established: (1) the relation space, which provides a set theoretic foundation for all subsequent work; (2) the family of submodels, which is the most convenient format for man to conceive and to manipulate; (3) the bipartite graph, which provides the topological properties of the model's relations and variables; and (4) the constraint matrix, which contains all the information of the bipartite graph in a format amenable to digital computer processing. Fundamental definitions of mathematical model consistency and computational allowability, are established on a set theory basis. Dissert. Abstr.

N68-34885 California Univ., Berkeley.

THE CUT LOCUS AND CONJUGATE LOCUS OF A RIEMANNIAN MANIFOLD

Alan David Weinstein (Ph.D. Thesis) 1967 23 p

Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-11674

Let M be any compact differentiable manifold not homeomorphic to S^2. We construct a Riemannian metric on M such that for a certain $p \in M$, the conjugate locus and cut locus in the tangent space M_p are disjoint. This disproves the conjecture mentioned by Rauch that this could not be done for a simply connected manifold. If $\dim M = 2$, the result is contained in standard examples. If $\dim M \geq 3$, we start with any metric on M and use the *Proposition*. There is a real number $\Delta(M)$ such that for any $\varepsilon > 0$, there is an ε-dense embedding of $[0,1]$ in M with geodesic curvature everywhere $< \Delta(M)$. (We show in an aside that any positive number will work as $\Delta(M)$.) The image of a sufficiently dense embedding is surround by a sphere S whose outer cut locus and focal locus are disjoint. A new metric inside S makes S the unit sphere about a point p. Dissert. Abstr.

N68-34942 Nebraska Univ., Lincoln.
SOLUTIONS TO BOUNDARY VALUE PROBLEMS AND PERIODIC SOLUTIONS OF SECOND-ORDER NONLINEAR DIFFERENTIAL EQUATIONS
Klaus Schmitt (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-15839

In this dissertation we consider the nonlinear second-order differential equation (A) $x'' = f(x,x',t)$. We give sufficient conditions for the existence of a solution of (A) (1) which is periodic, (2) having prescribed boundary values at the end points of a finite interval, (3) having one boundary value prescribed at the finite end point of a half infinite interval, (4) on the whole real line, and (5) satisfying the mixed boundary conditions $a_0x(a) - a_1x'(a) = c$, $b_0x(b) + b_1x'(b) = d$ at the end points of the finite interval [a,b]. Dissert. Abstr.

N68-34950*# Arizona Univ., Tucson. Analog/Hybrid Computer Lab.
HYBRID-COMPUTER MONTE CARLO TECHNIQUES FOR FINDING EIGENVALUES OF PARTIAL DIFFERENTIAL EQUATIONS
Richard D'Aquanni Sep. 1968 42 p refs
(Grant NsG-846)
(NASA-CR-96881; ACL-Memo-160) CFSTI: HC $3.00/MF $0.65 CSCL 12A

This paper describes a Monte Carlo technique for estimating the lowest eigenvalues of certain elliptical partial differential equations with various boundary conditions. A stochastic process whose output conditional probability density distribution satisifies a partial differential equation similar to the partial differential equation under consideration is, along with the boundary conditions, implemented on ASTRAC II, a fast repetitive analog computer. Eight different boundaries in one, two, and three-dimensional space were implemented, resulting in eight lowest-eigenvalue estimates, which are compared to the true lowest eigenvalues. Computer hardware errors, along with the error resulting from the mathematical approximation employed in deriving the estimate, are indicated. Corrective measures are included when necessary. Applications result from a presentation of analogies relating the partial differential equations under consideration to partial differential equations modeling physical processes. Author

N68-35020 Texas Univ., Austin.
KILLING VECTORS IN EMPTY, ALGEBRAICALLY SPECIAL EINSTEIN MANIFOLDS WITH DIVERGING RAY CONGRUENCES
George Charles Debney, Jr. (Ph.D. Thesis) 1967 141 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-14818

The conformal (Weyl) tensor of a gravitational field may be represented in terms of complex null bivectors, from which the Petrov algebraic classification of such fields emerges. In particular, empty Einstein manifolds lend themselves to this process. The two prominent classes are the "algebraically general" and the "algebraically special" manifolds. The multiple-Debever vector field, k, is called the ray congruence. The manifold E is then defined as an albegraically special empty Einstein manifold for which the complex divergence of k is non-zero; i.e., k is a diverging ray congruence. The field equations, $R_{ab} = 0$, the equations of structure allow one to pick a coordinate system and a null tetrad defined uniquely up to a certain group of allowed transformations. From these considerations all but three of the field equations for E may be integrated explicitly. From elementary considerations of groups of motion in E one may derive the form which a Killing vector, K, must have if it is to exist. Consideration of Killing's equations and integrability conditions for these gives an interesting results: E can have no more than four Killing vector fields. In fact, if there exist more than two Killing vectors, then one of these may be expressed in a particularly simple canonical form. Behavior of the field equations under the assumption of multiple Killing vectors is investigated to yield, in particular, all metrics of E which have three of four Killing vectors. Among the spaces having two Killing vectors there is one which is a generalization of the Kerr solution and one for which the Killing vectors do not commute. Only minor simplification of the field equations was evident whenever just one Killing vector was allowed. Dissert. Abstr.

N68-35035 Polytechnic Inst. of Brooklyn, N. Y.
MEASURE AND INTEGRATION IN NON-ARCHIMEDIAN BANACH SPACES
Martin Fried (Ph.D. Thesis) 1967 130 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-13389

Measure and integration theories are investigated in settings where one encounters a field with non-archimedian valuation. The first notion investigated is that of an (F-valued) measure μ. The next notions investigated are those of strong measurability and integrability for functions defined on a measure space (Ω, S, μ) assuming values in F. Attention is next focused upon integration theory for functions defined on (Ω, S, μ) and assuming values in a Banach space X over F, where F is complete. Lastly, an integral is introduced for functions defined on (ω, S, μ) assuming values in a Banach algebra X over F, where F is complete. Dissert. Abstr.

N68-35047 Lehigh Univ., Bethlehem, Pa.
THE GROUP OF CONFORMAL TRANSFORMATIONS OF A COMPACT RIEMANNIAN MANIFOLD
Jong-Diing Liu (Ph.D. Thesis) 1967 29 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-14944

A theorem is extended for the following case: let $C(M^n)$, $I(M^n)$ be respectively the groups of conformal transformations and isometries of a Riemannian manifold M^n of dimension n, and $C_0(M^n)$, $I_0(M^n)$ respectively the connected components of the identities of $C(M^n)$, $I(M^n)$. Dissert. Abstr.

N68-35055 Northwestern Univ., Evanston, Ill.
SOME COMPLETENESS THEOREMS FOR LOCALLY CONVEX SPACES
Carl Louis DeVito (Ph.D. Thesis) 1967 32 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-15219

Consideration is given to the subjects of reflexivity and weak compactness in locally convex spaces. The results known in this area, can be proved only for spaces which are quasi-complete for a suitable topology. The main objective is to prove some theorems which give sufficient conditions for a locally convex space to be quasi-complete. Several applications of these theorems are discussed. Dissert. Abstr.

N68-35106# Queens Univ., Kingston (Ontario). Mathematics Dept.
SERIES EXPANSIONS FOR RANDOM PROCESSES
L. L. Campbell May 1968 41 p refs
(Contract DRB-713000)
(RR-68-3) CFSTI: HC $3.00/MF $0.65

Let X(t) be a stationary random process with mean zero, standard deviation σ, and spectral density function $\sigma^2 w(f)$. Let $L_2[w]$ be the Hilbert space of functions with inner product $(g,h) = \int g(f)\overline{h}(f)w(f)df$. Let $K[w]$ be the set of functions G which have the representation $G(t) = (g(f), e^{-i2\pi ft}$ for some $g \in L_2[w]$. Define an inner product on $K[w]$ by $\langle G,H \rangle = (g,h)$, where G is as above and $H(t) = (h(f), e^{-i2\pi ft})$. Then $K[w]$ is a reproducing kernel Hilbert space. It is shown that the possibility of representing the inner product $\langle G,H \rangle$ as an integral depends on the possibility of

solving an integral equation. This same equation occurs in discussions of the detection of a known signal in noise. As an illustration of the possible use of these series, one detection problem is analyzed. It is shown in two ways that the information gain $\int w_1 \log(w_1/w)\, dl$, can be interpreted as a measure of the difference between w and w_1. Author

N68-35183# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

A NOTE ON DECISION RULES FOR STOCHASTIC PROGRAMS

David W. Walkup and Roger J.-B. Wets May 1968 15 p refs *Its* Math. Note 560

(DI-82-0727; AD-673120)

It is shown that a two-stage stochastic program with recourse with right-hand sides random (i.e., a two-stage programming under uncertainty problem) has optimal decision rules which are continuous and piecewise linear. However, this result does not extend to programs with three or more stages. An example is given of a simple inventory-type three-stage stochastic program with recourse for which the the optimal second-stage decision rule is not piecewise linear. The example is also recast in the framework of the conditional probability E-model of chance-constrained programming showing that the Charnes-Kirby theorem on the existence of piecewise linear decision rules for such programs is invalid for more than two stages. Author (TAB)

N68-35201# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

THE USE OF FRACTIONAL INTEGRAL OPERATIONS FOR SOLVING NONHOMOGENEOUS DIFFERENTIAL EQUATIONS

T. P. Higgins Dec. 1967 22 p refs *Its* Math. Note 541

(DI-82-0677; AD-673037)

Although results using fractional integral operators can always be obtained by other methods, the succinct simplicity of the formulation may often suggest approaches which might not be evident in a classical approach. In this note homogeneous fractional integral operators and a homogeneous integral operator related to the Laplace transform are defined and some applications to nonhomogeneous differential equations are given. Author (TAB)

N68-35203# Stanford Univ., Calif. Dept. of Computer Science.

A NUMERICAL INVESTIGATION OF THE SIMPLEX METHOD

Richard H. Bartels 31 Jul. 1968 124 p refs

(Contracts N00014-67-A-0112; NSF GP-5962)

(CS-104; AD-673010)

The report analyzes the behavior of the round-off errors associated with three different computer implementations of the simplex method of linear programming. One of the three is representative of computer implementations in common use, and it is shown that the standard method of updating the basic-matrix inverse is numerically unstable. The remaining two implementations are suggested by the author and use triangular decompositions of the basic matrix as substitutes for its inverse. The implementations are shown to be stable, and one of them is shown to be competitive in speed with the standard simplex-method computer implementations. Error bounds which may be calculated from intermediate results are developed for each of the three implementations, and their use during computation for error monitoring and control is discussed. Author (TAB)

N68-35209# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.

SOME GENERALIZED EIGENFUNCTION EXPANSIONS AND UNIQUENESS THEOREMS

Arthur S. Peters Jun. 1968 44 p refs

(Contract Nonr-285(55))

(IMM-368; AD-673008)

A generalized eigenfunction expansion method, Churchills method, and a transform method are used to investigate the uniqueness of the solution of the equation ((the partial derivative with respect to y of p(y)) (the partial derivative with respect to y of phi(x,y)) + q(y)phi + (r/y) the second partial derivative of phi with respect to x) = 0), minus infinity < x < plus infinity, 0 < y < 1 subject to the boundary conditions phi sub y(x,0) + (alpha sub 0) phi sub xx (x,0) + (beta sub 0) phi (x,0) = 0 and phi sub y (x, 1) + (alpha sub 1) phi sub xx (x, 1) + (beta sub 1) phi (x, 1) = 0. Author (TAB)

N68-35246# Research Analysis Corp., McLean, Va.

GENERALIZED PENALTY METHODS IN TOPOLOGICAL SPACES

Anthony V. Fiacco and Arnold P. Jones Aug. 1968 16 p refs

(Contract DA-44-188-ARO-1)

(RAC-TP-326; AD-673100)

The sequential unconstrained minimization technique solves a constrained minimization problem by minimizing a sequence of auxiliary functions. Assuming the existence of a sequence of points related to the minimizing sequence, the usual convergence results are shown to hold in a general topological space. This generalizes certain results obtained previously at RAC and elsewhere. Author (TAB)

N68-35276# California Univ., Los Angeles. Western Management Science Inst.

CONSTRAINED MAXIMUM LIKELIHOOD ESTIMATION OF N STOCHASTICALLY ORDERED DISTRIBUTIONS

Arthur M. Geoffrion 1968 41 p refs

(Contract Nonr-233(75))

(WMSI Working Paper-138; AD-673232)

The study considers the problem of determining step function maximum likelihood estimates for N stochastically ordered distributions, subject to the constraint that the estimates themselves must also be stochastically ordered. This problem arises, for example, in the context of reliability growth. Brunk, et al., has achieved a closed form solution for the case $N = 2$, but was unable to extend the results to the case $N > 2$. We shall present a new analytical method based on the Kuhn-Tucker optimality conditions for the equivalent concave program. For $N = 2$, the method yields the closed form solution of Brunk, and for $N = or > 3$, the method yields an efficient computational algorithm. Author (TAB)

N68-35277# Wisconsin Univ., Madison. Dept. of Statistics.

INDEPENDENCE AND STATISTICAL REDUCTION FOR INVARIANT MODELS

James Bondar May 1968 30 p refs

(Contract Nonr-1202-17)

(TR-163; AD-673237)

A theorem is derived, proving the independence of minimal sufficient statistics and the natural ancillary statistic for a class of invariant models. The theorem is applied to prove the equivalence of different methods of reducing statistical models, e.g. invariance reductions and sufficiency-followed-by-invariance reductions. Author (TAB)

N68-35340# California Univ., Berkeley. Center for Research in Management Science.

CONVERGENCE CONDITIONS FOR NONLINEAR PROGRAMMING ALGORITHMS

W. I. Zangwill Mar. 1968 24 p refs
(Contract Nonr-222(77))
(WP-197; AD-672928)

Conditions which are necessary and sufficient for convergence of a nonlinear programming algorithm are stated. It is also shown that the convergence conditions can be easily applied to most programming algorithms. As examples, algorithms by Arrow, Hurwicz and Uzawa; Cauchy; Frank and Wolfe; and Newton-Raphson are proven to converge by direct application of the convergence conditions. Also the Topkis-Veinott convergence conditions for feasible direction algorithms are shown to be a special case of the conditions stated in this paper. Author (TAB)

N68-35344# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
INTEGER VECTOR REPRESENTATION OF BOOLEAN FUNCTIONS
Takayuki Kimura (M.S. Thesis) May 1968 42 p refs
(Contract DA-31-124-ARO(D)-98; Grant NSF GP-5661)
(AROD-4166: 13-M; Rept.-68-36; AD-673125)

The following main theorem is proved in this paper: The number of centers of symmetry of a symmetric function f(x sub 1, x sub 2, ..., x sub n) is 2 to the nth power if and only if f = 0 or f = 1 or f = x sub 1 (+ circled) x sub 2 (+ circled) ... (+circled) x sub n (+ circled) c (c = 0, 1); otherwise it is 2. Author (TAB)

N68-35349# Basel Univ. (Switzerland). Mathematics Inst.
BOUNDS FOR THE MAXIMUM AND MINIMUM EIGENVALUES OF AN HERMITIAN MATRIX
Emilie V. Haynsworth Jun. 1968 4 p refs
(Contract DA-91-591-EUC-3946)
(BMN-22; AD-673139)

In this note we combine the results of two well-known theorems to obtain easily-computed upper and lower bounds for the maximum and minimum characteristic roots of an Hermitian matrix. Author (TAB)

N68-35350# System Development Corp., Santa Monica, Calif.
ON THE INTEGRATION OF ELEMENTARY FUNCTIONS WHICH ARE BUILT UP USING ALGEBRAIC OPERATIONS
Robert H. Risch Jun. 1968 30 p refs
(SDC-SP-2801/002/00; AD-672787)

This paper advances the study of the problem of integration of elementary functions in finite terms to within one step of a complete solution. A previous paper gave an algorithm for integrating those elementary functions which are built up using rational operations, exponentials and logarithms, under the condition that the exponentials and logarithms could not be replaced by adjoining constants and performing algebraic operations. Now it is shown that with algebraic operations allowed, the problem reduces to a problem in the theory of algebraic functions which is believed to be decidable. Author (TAB)

N68-35389# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
PAULI ALGEBRA AND THE RESTRICTED LORENTZ GROUP
Final Report, Part 1, Sep. 1965-Jun. 1968
Laszlo Tisza and Cynthia K. Whitney Jul. 1968 67 p refs
Submitted for publication
(Contract Nonr-3963(24))
(Rept.-1; AD-672821)

The structure of the Pauli algebra of 2 x 2 matrices is studied by a combination of standard algebraic techniques with those of complex quaternions. The presentation is self-contained and results in a calculus that is a connecting link between elementary vector calculus and spinor calculus. The formalism is applied to the parametrization of a homogeneous restricted Lorentz group. The structure of this group becomes more transparent in this treatment than in the usual tensoral method. Author (TAB)

N68-35394# Naval Ordnance Lab., White Oak, Md.
THE SOLUTION OF SOME SINGULAR CAUCHY PROBLEMS
J. M. Solomon 31 Jul. 1968 110 p refs
(NOLTR-68-105; AD-673004)

Singular Cauchy problems which are generalizations of the classical Euler-Darboux-Poisson (EPD) problem are considered. Solutions are obtained in some instances using transmutation operators and in other cases using integral operators. Uniqueness and Huygens property of the solutions are discussed. Author (TAB)

N68-35406# Basel Univ. (Switzerland). Mathematics Inst.
ON THE INERTIA OF SOME CLASSES OF PARTITIONED MATRICES
Emilie V. Haynsworth and Alexander M. Ostrowski Aug. 1967 26 p refs
(Contract DA-91-591-EUC-3946)
(BMN-18; AD-673140)

The paper is concerned with the determination of the inertia triple for certain partitioned Hermitian matrices. We make repeated use of the Sylvester-Hermite theorem that the inertia of an Hermitian matrix remains invariant under a cogredient transformation. That is, if K = P* HP, where P is a non-singular matrix and H is Hermitian, then K is also Hermitian, and In K = In H. Author (TAB)

N68-35433# Northwestern Univ., Evanston, Ill. Technological Inst.
ON EXPLICIT SOLUTIONS OF INTERVAL LINEAR PROGRAMS
Sanjo Zlobec and Adi Ben-Israel Jun. 1968 17 p refs *Its* Systems Res. Memo. 210
(Contracts Nonr-1228(10); DA-31-124-ARO(D)-322; Grant NSF GP-7550)
(AD-672584)

The results of A. Ben-Israel and A Charnes; 'An explicit solution of a class of special linear programming problems,' operations research (forthcoming) are extended here to the case of arbitrary rank. Author (TAB)

N68-35447# Aerospace Corp., San Bernardino, Calif.
A METHOD FOR DETERMINING PROBABILITY DISTRIBUTIONS FOR MASS PROPERTIES OF SYSTEMS
Frank C. Bond Jun. 1968 48 p refs
(Contract F04695-67-C-0158)
(TR-0158(S3960-30)-2; AD-672760)

An analysis is performed to develop expressions for the statistical parameters of system mass properties. It is assumed that the component weights, centers of gravity, and inertias have known probability distributions. The general forms of the density functions generated are deduced from the calculus of probability whenever applicable. Means and variances of the system mass properties are computed from linear functions of the statistical parameters of the components. The input random variables may be distributed according to any probability law or combination of probability laws for which the moments are known. From conceptual design to detailed specification drawings, the probability laws governing mass properties estimation change. This method may be utilized at any point in the life cycle of system design as it is independent of the particular forms of the distributions used as input. Author (TAB)

N68-35461# RAND Corp., Santa Monica, Calif.
COMBINING OVERLAPPING INFORMATION
Richard Zeckhauser Jul. 1968 11 p refs
(P-3890; AD-672953)

In group or organizational decision problems it is often desirable to combine the information derived from different sets of observations. Difficulties arise when there is some overlap in these sets, but the data cannot be sifted to identify the overlapping observations. This is one formulation of the problem that is encountered when we attempt to pool the probability judgments of a number of individuals with some separate and some common experience into a jointly assessed probability distribution. Author (TAB)

N68-35472*# TRW Systems Group, Redondo Beach, Calif.
MATHEMATICAL PROBLEMS OF MODELING STOCHASTIC NONLINEAR DYNAMIC SYSTEMS
Richard E. Mortensen Washington NASA Sep. 1968 53 p refs
(Contract NAS2-4553)
(NASA-CR-1168) CFSTI: HC$3.00/MF$0.65 CSCL 12A

The purpose of this report is to introduce the engineer to the area of stochastic differential equations and to point out some of the mathematical techniques and pitfalls in this area. Topics discussed include continuous-time Markov processes, the Fokker–Planck–Kolmogorov equations, the Ito and Stratonovich stochastic calculi, and the problem of modeling physical systems. Author

N68-35478# RAND Corp., Santa Monica, Calif.
SEMI-MARKOV PROCESSES: A PRIMER
Bennett Fox Aug. 1968 36 p refs Submitted for publication
(P-3577-2; AD-673152)

Marrying renewal processes and Markov chains yields semi-Markov processes, and the former are special cases of the latter. In this expository paper, some of the main properties of the union are outlined. Author (TAB)

N68-35479# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
A CONDITION FOR THE DISCRETENESS OF THE NEGATIVE SPECTRUM OF THE SCHROEDINGER OPERATOR
G. M. Zhislin 27 May 1968 11 p refs Transl. into ENGLISH from Usp. Mat. Nauk (Moscow), v. 19, no. 6(120), 1964 p 155–160
(Contract NOw-62-0604)
(APL-CLB-3-T-554; AD-673161)

Let H be a symmetric operator with dense domain of definition in a Hilbert space. Let H^e be its Friedrichs self-adjoint extension. The author gives necessary and sufficient conditions for the operator H to be bounded below and for the operator H^e to have a negative discrete spectrum (theorem 1). He then uses theorem 1 to extend the region of application of the criteria of discreteness of the negative spectrum of the Schrodinger operator (theorem 2), which was previously deduced by I. M. Glazman and also by A. Persson. However, in contrast to Persson the class of operators is not restricted by the requirement that the potential be bounded below at infinity. TAB

N68-35508# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE METHOD OF STRAIGHT LINES IN THE APPLICATION TO CERTAIN BOUNDARY PROBLEMS [METOD PRYAMYKH V PRIMENENII K NEKOTORYM KRAYEVYM ZADACHAM]
V. N. Faddeyeva 14 Jul. 1967 49 p refs Transl. into ENGLISH from Tr. Mat. Inst. Akad. Nauk SSR (Moscow), v. 28, 1949 p 73–103
(FTD-MT-66-163; AD-673170)

Before the middle 1930s the prevailing method of the numerical solution of boundary value problems was the method of finite differences. About 1935 there appeared, several works devoted to the solution of partial differential equations with two variables, the basic idea of which is the preservation of the method of finite differences only for one change so that the solution of partial differential equations would lead to the solution of the system of ordinary differential equations. The character of this system depends on both the form of the equation and on the type of boundary conditions of the problem. In earlier published works of L. V. Kantorovich the solution of partial differential equations is reduced to the solution of the system of differential equations obtained from other more general considerations. By analogy with the method of grids, it is natural to call the mentioned group of methods, the methods straight lines and lines. Calculations reported in this paper show the effectiveness of the method of straight lines, and therefore, the application of it for a numerical solution of boundary problems as expedient. TAB

N68-35578# Northwestern Univ., Evanston, Ill. Technological Inst.
A SUBOPTIMIZATION METHOD FOR INTERVAL LINEAR PROGRAMMING. A NEW METHOD FOR LINEAR PROGRAMMING
Philip D. Robers and Adi Ben-Israel Jun. 1968 33 p refs Presented at the Soc. for Ind. and Appl. Math., Toronto, Jun. 1968 *Its* System Res. Memo. 204
(Contract Nonr-1228(10); DA-31-124-ARO(D)-322; Grant NSF GP-7550)
(AD-672582)

An interval program is (1P) max (c,x) S.T. $B- \le Ax \le B+$ where the matrix A vectors C,B−,B+ are given, the explicit solution of (1P) in the case that A has full row rank (A. Ben-Israel and A. Charnes: 'an explicit solution of a special class of linear programming problems,' operations research, forthcoming) is used here in an iterative method for solving the general (1P). This method applies to general linear programs and is shown to be a dual method with multiple substitution, some computational experience is given. Author (TAB)

N68-35581# California Univ., Berkeley. Dept. of Mathematics.
CONDITIONALLY STABLE INVARIANT MANIFOLDS OF SYSTEMS OF DIFFERENTIAL EQUATIONS WITH OR WITHOUT DELAY Technical Report, 1967–1968
Sherwood W. L. Samn Jun. 1968 99 p refs
(Contract Nonr-222(88))
(AD-672573)

The existence and smoothness of the stable manifold of invariant manifolds of systems of differential (−difference) equations of the form $d(theta)/dt = A + theta(T, Theta(T-R), X(T-R), Y(T-R))$: $DX/DT = A_1(T, Theta)X(T-R) + X(T, Theta(T-R), X(T-R), + X(T, Theta(T-R), X(T-R), Y(T-R))$; $DY/DT = A_2(T, Theta)Y(T-R) + Y(T, Theta(T-R), X(T-R), Y(T-R))$ where $R \ge 0$, and A is a constant. A sub 1, 1 = 1,2, are matrices, and are constant if R is not equal to 0. The results in this study are generalizations of some results of Coddington and Levinson, and of Hale. Author (TAB)

N68-35730*# Bellcomm, Inc., Washington, D. C.
APPROXIMATE SOLUTIONS OF M NONLINEAR EQUATIONS IN N UNKNOWNS FOR M > N
C. L. Greer 6 Aug. 1968 10 p refs
(Contract NASw-417)
(NASA-CR-97073; TM-68-1014-5) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A system of M nonlinear equations in N unknowns with M>N may be considered as a vector function F(X) mapping R^N into R^M. The technique of differentiation with respect to a parameter is applied in a general fashion to solve the equation F(X)=0. This approach reduces the problem to integrating a system of first order differential equations. In general, numerical integration which yields approximate solutions to F(X)=0 must be used. Author

N68-35753# Argonne National Lab., Ill. Applied Mathematics Div.
A STUDY OF SOME NUMERICAL METHODS FOR THE INTEGRATION OF SYSTEMS OF FIRST-ORDER ORDINARY DIFFERENTIAL EQUATIONS
Nancy W. Clark Mar. 1968 26 p refs
(Contract W-31-109-ENG-38)
(ANL-7428) CFSTI: HC $3.00/MF $0.65

A study of some numerical methods for the integration of systems of first order ordinary differential equations which describes the extrapolation methods of Bulirsh-Stoer and Neville, presents the results of some tests comparing the extrapolation methods with the Runge-Kutta and Adams-Moulton methods, and shows some of the circumstances under which the extrapolation method may be preferred is discussed. Results of double-precision tests of the Bulirsch–Stoer method are presented to show the efficiency of various orders of this method as a function of desired accuracy. Author (NSA)

N68-35793# Los Alamos Scientific Lab., N. Mex.
O(H TO THE 2n + 2– L POWER) BOUNDS ON SOME SPLINE INTERPOLATION ERRORS
Blair Swartz 19 Jun. 1968 24 p refs
(Contract W-7405-ENG.36)
(LA-3886) CFSTI: HC $3.00/MF $0.65

Certain spline interpolations (of odd degree) to smooth functions at uniformly spaced joints are considered. Certain cubic spline interpolations at arbitrarily spaced joints are also discussed. Good error bounds are obtained in all cases, for the errors are essentially those of a local two-point Polya interpolation. Author (NSA)

N68-35800# California Univ., Los Angeles.
AN APPLICATION OF A NEWTON LIFE METHOD TO THE EULER–LAGRANGE EQUATION
Richard A. Tapia 1968 20 p refs
(Contract NONr-233(76))
(AD-672929)

It is known that any function which minimizes a functional of the form J(y) = the integral taken from a to b, of f(x,y,y) and satisfies prescribed boundary values must be a solution of the corresponding Euler-Lagrange equation: f sub 3(x,y,y) - (the integral taken from a to x of f sub 2(x,y,y)) = c. Let us call any equation of the form: g(x,y,y) - (the integral taken from a to x of h(x,y,y)) = c a generalized Euler-Lagrange equation. In this paper we propose a Newton-like method and show that this proposed method is general enough to enable us to construct solutions of the generalized Euler-Lagrange equation. Author (TAB)

N68-35884*# Maryland Univ., College Park. Computer Science Center.
CLASSES OF SEMIDEFINITE PEANO–KERNELS
Manfred Reimer Jul. 1968 31 p refs
(Grant NGR-21-002-018)
(NASA-CR-97102; TR-68-73) CFSTI: HC $3.00/MF $0.65 CSCL 12A

For error estimations concerning quadrature or multi-step methods related to a finite difference form, a basic question is whether the associated Peano-kernel has a fixed sign. It is proved that this is true in general if the form is stable and of highest possible degree as well as in many other cases. Author

N68-35956# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
GEOMETRICAL PROPERTIES IN STATE SPACE OF LINEAR DIFFERENTIAL EQUATIONS WITH PERIODIC COEFFICIENTS
P. C. Hughes Jul. 1968 41 p refs
(Contract AF-AFOSR-1490-68; AF-AFOSR-222-66)
(UTIAS-TN-127; AD-673879)

In an attempt to more completely visualize the solution vector to a system of linear differential equations with periodic coefficients, geometrical properties in state-time space are derived in detail for second order systems. The solution vector is found to be on a surface which is periodic in time and whose cross-section is elliptic. The connection between these surfaces and Liapunov stability is pointed out. An example is discussed in the area of satellite attitude dynamics. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-34837# Joint Publications Research Service, Washington, D. C.
METEOROLOGY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 187 4 Sep. 1968 p 7–24 (See N68-34835 22-13)

Sino-Soviet publications in the field of meteorology are reported. Cited are news items on hail suppression measures in Kabardino–Balkarskaya (USSR); the status and prospects for long range weather forecasts in Kazakhstan; the IL-18 flying weather laboratory; the All-Union conference on floods and flood protection in Khabarovsk which was conducted in Khaborovsk, August 1968; the Obnisk Weather Center; a new thermoanemometer containing a sensing element; and the accuracy in determining the altitude of a radiosonde using a telemetric attachment to the Malakhit radiotheodolite at aerological stations of the hydrometerological service of the UZBEK USSR. Also included are abstracts of scientific articles among which are cited studies of the hydrodynamics of cloud systems; a quasigeostrophic model of geopotential forecasting; the effect of low pressure areas (i.e., the dependence of winter atmospheric temperature upon the geometrical configuration of a depression); inherent problems associated with studies of permafrost regions and glaciers; atmospheric circulation over the Northern Hemisphere; statistical characteristics of atmospheric circulation; the small scale structure of atmospheric turbulence; and the lower tropopause in Antarctica. S.C.W.

N68-35000 Florida State Univ., Tallahassee.
THE DYNAMICS OF THE STRATOSPHERE DURING THE 1958 WARMING
William Alan Bowman (Ph.D. Thesis) 1967 136 p
Available from Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 67-14444

Maps of height, z, and temperature, T, for 100, 50, and 25 mb, for every other day of the period, illustrate the onset of the warming in the region of the warm belt, and the subsequent migration of the warm center from the Mediterranean, across

western Europe, Iceland, and Canada. Vertical motion, ω, at 100, 50, and 25 mb was computed by the adiabatic method, and maps are presented for every fourth day from January 21 to February 6. Horizontal divergence, $\nabla \cdot \vec{V}$, was computed at 100, 75, and 50 mb from a differentiated form of the adiabatic energy equation. Comparisonof $\nabla \cdot \vec{V}$ maps with the ω maps showed that generally sinking (rising) motion was accompanied by horizontal convergence (divergence). The breakdown of this relationship between $\nabla \cdot \vec{V}$ and ω, at the height of the warming, is discussed. Vorticity, ζ, and the vorticity budget at 100, 50, and 25 mb were evaluated for the period. Dissert. Abstr.

N68-35077# Weather Wing /4th/, Ent AFB, Colo. Aerospace Sciences Div.

AN OBJECTIVE TECHNIQUE FOR FORECASTING CONDITIONS BELOW VFR IN STRATUS AND FOG AT PETERSON FIELD, COLORADO SPRINGS, COLORADO

Kenneth B. Knechtel Jun. 1968 40 p

(AD-672270)

The paper describes a partially automated investigation, using an IBM 7090 computer, to develop objective forecast techniques for forecasting ceiling/visibility conditions less than 1500 feet and/or 3 miles at Colorado Springs, Colorado. Six forecast techniques (three seasonal periods and two forecast periods) complete with forecast checklists and the selected scatter diagrams are presented as a final result of the investigation. Author (TAB)

N68-35080# San Fernando Valley State Coll., Northridge, Calif.

CLIMATIC NORMALS AS PREDICTORS. PART 3: MEDIAN VS. MEAN

William F. Slusser May 1968 101 p refs

(Contract AF 19(628)-5716)

(Rept.-82-68-1; AFCRL-68-0255; SR-3; AD-672268)

Rainfall and other variables with similarly skewed distributions are hard to characterize climatically due to their extreme variability. The arithmetic mean, generally used, is greatly influenced by extreme values. For rainfall data from 219 stations located in the western United States, the median was found to be a more representative value, and somewhat better than the mean for predicting future rainfall amounts. Some monthly precipitation frequency distributions are so greatly skewed that values smaller than the mean occur 90% of the time. Because any single measure of central tendency is inconclusive, measures of absolute and relative variability are summarized. Maps of percentage occurrence of the mean, ratio between median and mean, coefficient of variation (CV), and relative variability (Vq) are presented for the mid-season months--Jan, Apr, Jul, and Oct. Author (TAB)

N68-35145*# Stanford Research Inst., Menlo Park, Calif.

REMOTE PROBING OF HIGH CLOUD COVER VIA SATELLITE-BORNE LIDAR Final Report

William E. Evans Aug. 1968 131 p refs

(Contract NASr-49(27); SRI Proj. 6822)

(NASA-CR-96893) CFSTI: HC $3.00/MF $0.65 CSCL 04B

A series of measurements with a calibrated ruby lidar on a variety of cirrus cloud situations is compared with the appearance of these cloud situations as observed visually from the ground and via APT and AVCS television pictures from the ESSA weather satellites. Reduced lidar data, Kodachrome cloud photographs, satellite photographs, synoptic charts, and vertical profiles of wind, temperature, and humidity are presented for fourteen operating sessions on ten different days, at Menlo Park, California. For some of the soundings, concurrent measurements of two-way transmission through the clouds were made by comparing the strength of lidar returns via Rayleigh molecular scattering from clear regions above the cloud decks with similar returns obtained when no clouds were present. Author

N68-35217# Finnish Meteorological Office, Helsinki.

THE CLIMATE OF FINLAND--A BIBLIOGRAPHY WITH PARTICULAR REFERENCE TO APPLICATIONS [SUOMEN ILMASTOBIBLIOGRAFIA ERITYISESTI SOVELLUTUKSIA VARTEN]

Seppo Huovila and Anneli Pollari 1968 171 p refs In FINNISH; ENGLISH summary

(REPT.-15) CFSTI: HC $3.00/MF $0.65

Publications relating to the climate of Finland are listed by author and title according to the international decimal classification for the field of meteorology. Sea ice and ground frost publications are listed in addition to studies dealing with weather forecasting, atmospheric composition and pressure, air and earth temperature, and radiation. Other topics include wind properties and effects, humidity and evaporation, components in air motions, clouds, and precipitations. General references to climatology include to micro and meso aspects, bioclimatology, and environmental and cosmic influences. Applicable bibliographies and atlases are also referenced. Author and subject indexes are included for this bibliography, which includes works of Finnish authors published in either Finland or other countries. M.W.R.

N68-35241 National Lending Library for Science and Technology, Boston Spa (England).

A TECHNIQUE FOR OBJECTIVE ANALYSIS OF THE WIND FIELD AT THE 850, 500 AND 300 mb LEVELS

M. O. Kricak 17 Jul. 1968 13 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 1, 1968 p 21-27 In ENGLISH and RUSSIAN

(M-542)

An analysis by the method of optimal interpolation is described in which the values of the components of the wind vector at the points of the regular network are found. A computer program is given which permits interpolation of the fields of the wind vector components U and V at the levels 850, 500, and 300 mb at the points of the so called "small" forecasting grid (North Atlantic, Europe, Western Siberia), 26 x 22 in size with a grid length of 300 km. Computing time for the program on the M-20 electronic computer is 5 minutes. The program can be adapted also for analysis at a greater number of levels without increasing the calculation time very much. Author

N68-35245# Little (Arthur D.), Inc., Cambridge, Mass.

THE STATE OF CONDENSED WATER IN THE ATMOSPHERE

R. A. Horne and H. F. Eden 30 Aug. 1968 6 p refs

(Contract Nonr-4424(00))

(TR-35; AD-673093)

New data and theories of interfacial water structure should be applicable to the state of finely divided condensed water droplets in the atmosphere. Author (TAB)

N68-35249# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.

INTERRELATIONSHIPS BETWEEN THERMODYNAMIC VARIATIONS IN THE TROPOSPHERE AND THE LOWER STRATOSPHERE

Dorothy Ann Stewart 5 Apr. 1968 115 p refs

(RR-TR-67-14; AD-673116)

Interlevel correlation coefficients between pairs of thermodynamic variables have been computed at 2-kilometer intervals from the surface to 28 kilometers for several stations throughout the world. In this report tables of correlations are presented for the following three stations Thule, New York, and Albrook. Specifically, the following six types of information are tabulated: (1) correlation coefficients between temperatures at different levels; (2) interlevel

correlations between density and pressure; (3) interlevel correlations between temperature and pressure; (4) interlevel correlations between temperature and density; (5) correlations between densities at different levels; and (6) correlations between pressures at different levels. The report also contains several maps which illustrate the horizontal variations of certain correlations. Author (TAB)

N68-35255 National Lending Library for Science and Technology, Boston Spa (England).
THE USE OF SPECIAL FEATURES OF NATURAL SYNOPTIC SEASONS IN MAKING MONTHLY WEATHER FORECASTS
L. G. Borisova and L. M. Rudicheva [1968] 11 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Gidromet. (SSSR), no. 12, 1968 p 12–18 In ENGLISH and RUSSIAN
(M-7410) Available from Natl. Lending Library, Boston Spa, Engl.

Disturbances that occur in the large-scale processes that comprise a natural synoptic season are considered in terms of forecasting weather; and data obtained between 1960 and 1965 were used as the basis for the study. Six natural synoptic seasons were distinguished: (1) the first half of the summer began, on the average, May 9 and lasted through July 1, (2) the second half of summer July 2 and August 27, (3) autumn August 28 and October 20, (4) pre-winter October 21 through December 25, (5) winter December 26 to March 15, and (6) spring March 16 to May 8. In each of the preceding periods there are disturbances which are considered to characterize the next season, although such disturbances do not always occur on the same days or in the same sequence. Results obtained for studies of October, November and December disturbances indicate the feasibility of making predictions using the proposed method; and studies for other months are recommended. M.W.R.

N68-35256# Institut Royal Meteorologique de Belgique, Brussels.
BELGIAN ANTARCTIC EXPEDITION 1959. METEOROLOGICAL OBSERVATIONS AT VARIOUS ALTITUDES [EXPEDITION ANTARCTIQUE BELGE 1959. OBSERVATIONS METEOROLOGIQUES EN ALTITUDE]
Frank E. Bastin 1966 172 p In FRENCH Its Series A, No. 58
CFSTI: HC $3.00/MF $0.65

Meteorological observations made at the King Badouin base during the 1959 Belgian Antarctica expedition are presented in tabular form. These tables represent corrected data for observations made at various altitudes between January 1, 1959, and March 31, 1960. Transl. by M.W.R.

N68-35271 National Lending Library for Science and Technology, Boston Spa (England).
SOME RESULTS OF A STUDY OF SPATIAL TEMPERATURE IN HOMOGENEITIES
V. V. Navrockij, L. I. Kazachkina, and S. E. Navrockaja [1968] 23 p refs Transl. into ENGLISH from Okeanologiya (Moscow), v. 8, no. 1, 1968 p 14–22 In ENGLISH and RUSSIAN
(M-7378) Available from Natl. Lending Library, Boston Spa, Engl.

Dispersions and cross correlations of isothermal vertical variations were calculated from thermistor measurements of ocean temperature during the 38th voyage of the research vessel Vitjaz. It is concluded that there are internal waves in the layer, and their scales are determined. The nature of the cross correlations in cross sections was used to determine parameters (speed, length, direction of movement) of the integral internal wave using the Doppler effect. Comparison of the angular velocity for waves within the 58–80 m layer with the Vaisala frequency in the 0–100 m layer calculated from the vertical distribution of density at a buoy observation station shows that the resonance mechanism of wave development in a layer of discontinuity is not universal and may be important only under certain conditions. An observing procedure for making thermistor measurements is discussed, the aim being to obtain reliable information about internal waves and horizontal turbulence. Author

N68-35272 National Lending Library for Science and Technology, Boston Spa (England).
ON THE PROBLEM OF CALCULATING THE THICKNESS OF THE UPPER ISOTHERMAL LAYER OF THE SEA IN THE WARM PART OF THE YEAR
V. S. Krasjuk [1968] 26 p refs Transl. into ENGLISH from Tr. Tsentr. Naughn.-Issled. Gidromet. (SSSR), no. 3, 1967 p 40–48 In ENGLISH and RUSSIAN
(M-7381) Available from Natl. Lending Library, Boston Spa, Engl.

Indirect determination of the thickness of the upper isothermal layer of the sea in the warm part of the year is described. The technique takes into account changes in heat content of a 200 meter layer under given boundary conditions. Initial data on the vertical distribution of water temperature were taken 10, 20, and 30 days before the time of calculation. The accuracy with which the boundary layers of temperature discontinuity can be determined, using deep water observations at standard levels, was assumed to be an absolute of 10 m. Author

N68-35288 National Lending Library for Science and Technology, Boston Spa (England).
ON FORECASTING WATER TEMPERATURE IN THE NORTHWESTERN PART OF THE ATLANTIC OCEAN
L. I. Skriptunova [1968] 16 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Gidromet (SSSR), no. 3, 1967 p 32–39 In ENGLISH and RUSSIAN
(M-7384) Available from Natl. Lending Library, Boston Spa, Engl.

Observations from a 14-day hydrological station in the region of Georges Bank in the northwest Atlantic were used to trace successive changes of temperature in the active layer of the ocean. Analysis showed that the method of determining non-periodic water temperature changes from a given pressure situation allowing for heat fluxes across the ocean surface can be used for the hydrologically complicated northwest Atlantic. Preliminary equations using facsimile charts are derived for forecasting these temperature distributions. B.P.

N68-35294# Hydronautics, Inc., Laurel, Md.
WIND STRESS AND SURFACE ROUGHNESS AT AIR-SEA INTERFACE
Jin Wu Dec. 1967 37 p refs
(Contract Nonr-3688(00))
(TR-231-18; AD-672750)

Based on the compiled data of thirty independent observations, the report presents the wind-stress coefficient, the surface roughness and the boundary layer flow regime at the air-sea interface under various wind conditions. Both the wind-stress coefficient and the surface roughness are found to increase with the wind velocity when U10 is less than 15 m/sec and reach a saturated value for U10 greater than 15 m/sec. Based on the oceanic wave observations, it states that this discontinuity at U10 = 15 m/sec is due to an increase in the wind velocity (measured at the significant wave amplitude above the mean water level) beyond the average wave phase velocity. This finding provides a well-defined separation for the often quoted terms light and strong winds, and also explains the existence of the so-called critical wind velocity. It also shows that the surface roughness is governed by the amplitude of the short gravity waves rather than the mean square surface slope. Charnocks relationship is shown to be applicable to most of the data and Charnocks proportionality constant is determined. Finally, two approximate formulae for the wind-stress coefficient, one for light wind and the other for strong wind are suggested. Author (TAB)

N68-35297 National Lending Library for Science and Technology, Boston Spa (England).
THE SUMMER OF 1967 IN THE NORTHERN HEMISPHERE
Ju. S. Petrovskij [1968] 8 p Transl. into ENGLISH from Priroda (Moscow), no. 12 p 115–117 In ENGLISH and RUSSIAN
(M-7390) Available from Natl. Lending Library, Boston Spa, Engl.

A discussion is presented on the unusual summer meteorological phenomena, attributed to the low polar cyclonic vortex in the middle levels of the troposphere and to the normal subtropic anticyclone positions and intensities. These, along with an increase of zonality and greater degree of meridionality, are related to the approaching maximum of solar activity. Details are given on the circulation troughs and ridges,, surface pressure systems, cyclones and anticyclones, monsoon rains, and temperatures in the Northern Hemisphere. Particular attention is given to the cold and squalls over western Europe and Asia in June and July.
N.E.N.

N68-35316# Environmental Technical Applications Center (Air Force), Washington, D. C.
BIBLIOGRAPHIES OF CLIMATIC REFERENCES AND CLIMATIC MAPS FOR SELECTED COUNTRIES
Vincent J. Creasi Jul. 1968 11 p
(ETAC-TN-68-3; AD-672769)

The listing of climatological bibliographies for various countries is presented to furnish a ready reference to those Air Weather Service personnel whose duties or interests may involve an investigation of weather conditions of specific areas throughout the World. Each bibliography is listed with both its associated AD number and its Weather Bureau designation. These publications were compiled by the Foreign Area Section, Office of Climatology, of the U.S. Weather Bureau (now ESSA). Most of these bibliographies were sponsored (contracted) by the Air Weather Service through its Climatic Center (now USAF ETAC). Two distinct types of bibliographies are included: (1) a listing of climatic references and (2) a listing of Climatic Maps. All references included within the bibliographies have been abstracted to furnish the reader a quick resume of the contents therein. The source of each publication is noted.
Author (TAB)

N68-35318 National Lending Library for Science and Technology, Boston Spa (England).
ON FORECASTING THE MONTHLY ANOMALY OF AIR TEMPERATURE
D. A. Drogajcev [1968] 37 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Gidromet. (SSSR), no. 4, 1967 p 69–90 In ENGLISH and RUSSIAN
(M-7395) Available from Natl. Lending Library, Boston Spa, Engl.

The possibility of using the changes of 1000/500 mb thickness from one natural synoptic period to another in the long period forecasting of the monthly anomalies of atmospheric pressure and air temperature (ΔT) are investigated. The network of points used in calculating this difference consisted of 134 meteorological stations uniformly distributed over the first natural synoptic region which extends from the meridian of the southern tip of Greenland to the river Enisei in the east.
Author

N68-35326# Army Electronics Labs., Fort Monmouth, N. J.
NUCLEAR/WEATHER CLOUD INDICATOR
Casimir J. Matonis Apr. 1968 21 p refs
(ECOM-2966; AD-672749)

A feasibility study was conducted on the development of a new nuclear/weather data processing technique to provide a means of detecting and analyzing nuclear clouds or slow, small changes in weather patterns. When used with a radar set such as the AN/TPS-41(XE-1), this nuclear/weather cloud indicator will receive radar weather data, store the data on magnetic tape, and compare it with real-time information for both short and long-time comparisons. The difference between real-time and stored data, as displayed by the indicator unit, represents changes in the weather pattern or the instantaneous occurrence of a nuclear cloud.
Author (TAB)

N68-35376# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
CIRCULATION IN THE ARCTIC MESOSPHERE IN SUMMER
James E. Morris and Marvin D. Kays Jun. 1968 35 p refs
(ECOM-5181; AD-672752)

Wind data from the upper mesosphere over Fort Greely, Alaska, and Thule Air Base, Greenland, are presented. The data were gathered with small meteorological rockets and radar reflective chaff in July 1967. These data show increasing easterly winds with height throughout the mesosphere at high latitudes in summer with maximum speeds up to 92 mps and mean speeds near 50 mps in the 75-80 kilometer region. Diurnal and semidiurnal oscillations are resolved and compared with current theoretical values for atmospheric thermal tides.
Author (TAB)

N68-35399# Wisconsin Univ., Madison. Dept. of Meteorology.
MEASUREMENT OF ATMOSPHERIC AEROSOLS AND INFRARED RADIATION OVER NORTHWEST INDIA AND THEIR RELATIONSHIP
James T. Peterson Jan. 1968 177 p refs
(Contract Nonr-1202(07); Grant NSF GP-5572)
(TR-38; AD-673212)

The existence of large concentrations of atmospheric aerosols over northwest India, especially during the pre-monsoon season, has been noted by several sources. An annual distribution of aerosols at Delhi has been tabulated by Sekhon and Murty (1966). Finally, Raghavan and Yadav (1966) studied the influence of atmospheric particulates on solar radiation, or turbidity, at New Delhi for several years during the pre-monsoon season. In general, these reports indicate that large quantities of particulates are present in the atmosphere in northwest India, with the highest concentrations during the pre-monsoon season, and that these aerosols do influence the radiation of the area.
Author (TAB)

N68-35426 National Lending Library for Science and Technology, Boston Spa (England).
ON THE QUESTION OF THE SEASONAL AND INTERANNUAL VARIATION OF THE POSITION OF THE CENTRE OF THE ALEUTIAN DEPRESSION
G. N. Golovin [1968] 11 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Aeroklim. (USSR), no. 45, 1967 p 64–71 In ENGLISH and RUSSIAN
(M-7399) Available from Natl. Lending Library, Boston Spa, Engl.

The interrelationship between variations of the position of the center of the Aleutian depression and the redistribution of the heat resources in the active layer of the ocean is examined. It was found that: (1) The warm-centerdness of winters in the Bering Sea is a result of the seasonal displacement of the Aleutian depression from east to west and agrees with the variation of the axes of air advection. (2) The seasonal displacement of the Aleutian depression center occurs in agreement with the heat state of the active layer of the ocean. (3) The occurrence of warm center needs to be examined as a concentrated circulation index of atmosphere and hydrosphere in a natural synoptic region in a systematic respect. One must take the type of annual variation of air temperature at representative stations of the Aleutian depression zone as an indicator for grouping a number of years according to the identity of the circulation succession. (4) Warm center winters as a circulation index can serve as targets for the investigation of circulation succession, both interseasonal as well as interannual.
Author

N68-35446# Colorado State Univ., Fort Collins. Fluid Mechanics Program.
TOPOGRAPHIC INFLUENCES ON WIND NEAR GREEN RIVER, UTAH
G. Hsi, G. J. Binder, and J. E. Cermak Apr. 1968 61 p refs
(Contract DA-AMC-28-043-65-G20)
(CER67-68GH-GJB-JEC54; AD-673144)

Actual terrain near Green River, Utah, was modeled to a scale of 1:800. The purpose of this study was to find the effect of topography on wind speed and wind direction. Field data are included in this report and comparisons between model and prototype data are made. Throughout the study, an ambient wind velocity of 4.57 mps was used and a neutral flow condition was maintained in the Army Meteorological Wind Tunnel. Author (TAB)

N68-35448# Stanford Research Inst., Menlo Park, Calif.
THE TURBULENCE CLIMATOLOGY OF THE UNITED STATES BETWEEN 20,000 AND 45,000 FEET ESTIMATED FROM AIRCRAFT REPORTS AND METEOROLOGICAL DATA Final Report, 10 May 1965–9 Jun. 1968
Roy M. Endlich and Robert L. Mancuso Jun. 1968 71 p refs
(Contract AF 19(628)-5173)
(AFCRL-68-0337; AD-672988)

The climatology of clear-air turbulence is defined herein as the likelihood that an aircraft or missile will encounter turbulent air at a given locality, altitude, and time of year. Turbulence data of three types were used in this study; these include observations by instrumented research aircraft, balloon tracks measured by FPS-16 radar, and turbulence reports made by pilots. The FPS-16 tracks of rising Jimsphere and Rose balloons were obtained during studies of detailed wind profiles. We investigated their potential value in identifying turbulent layers. The subjective turbulence reports from pilots collected during special five-day reporting periods comprise by far the largest volume of data available. Meteorological conditions for these periods were analyzed by computer from standard rawinsonde data and were correlated with the turbulence reports. Optimum multiple regression equations between turbulence frequency and the mean and standard deviation of the vertical vector wind shear were obtained. In summer a different regression equation was found than in other seasons. Author (TAB)

N68-35473# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTEMPORARY CHANGE IN CLIMATE
Ye. S. Rubinshteyn and L. G. Polozova 9 Nov. 1967 288 p refs Transl. into ENGLISH of the book "Sovremennoye Izmeneniye Klimata" Leningrad, 1966 p 1–268
(FTD-MT-24-293-67; AD-672706)

In the book a survey is given of the basic works on the change in climate. Extensive factual data of variations in air temperature is given as one of the most important elements of climatic indices. Variations in temperature are investigated for each month of the year and on the average for the year on Earth from instrumental observations of the last 100-200 years. The connection is studied of the change in temperature with atmospheric circulation, solar activity, and ice cover of the Arctic and Antarctic seas. The book is intended for meteorologists, climatologists and all those who are interested in changes in climate. There are numerous graphs and tables, and in the appendix a list of meteorological stations and a map showing their location are given. Author (TAB)

N68-35481# Defense Documentation Center, Alexandria, Va.
WEATHER FORECASTING METHODS, VOLUME 1
Aug. 1968 305 p refs
(TAS-68-17; AD-673175)

This bibliography is a selection of Unclassified-Unlimited distribution references on WEATHER FORECASTING METHODS. Abstracts on numerical, statistical, and combined numerical and statistical prediction techniques predominate. This collection includes references to reports describing the use of graphic and synoptic data and studies of forecasting methods designed specifically for short-range, medium-range, and long-range predictions. References to analyses of forecast errors and developments in verification procedures are included. This report contains indexes of Subject, Personal Author, Corporate Author/Monitoring Agency, Contract Number, Report Number, and AD-Pagination. Another volume on Weather Forecasting Methods, AD-837 940, contains references to Unclassified reports with specific distribution limitations. Author (TAB)

N68-35512 National Lending Library for Science and Technology, Boston Spa (England).
ON THE STATISTICAL ASSOCIATION OF METEOROLOGICAL FIELDS FOR DIFFERENT PARTS OF A TERRITORY
K. M. Lugina [1968] 18 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 208, 1967 p 23–31
(M-7376) Available from Natl. Lending Library, Boston Spa, Engl.

The method of canonical correlations was used to study the problem of the statistical relationship between the meteorological fields of temperature and geopotential on the 500 mb surface for two different areas. The dependence of the coefficient of canonical correlation and the components of the weight vectors on the standard error of the observations was investigated. Author

N68-35513 National Lending Library for Science and Technology, Boston Spa (England).
A SCHEME OF OBJECTIVE ANALYSIS OF THE FIELDS OF METEOROLOGICAL ELEMENTS ON THE HEMISPHERE FOR A RANDOM NETWORK
A. A. Kobjakova and L. V. Ruhovec [1968] 24 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 208, 1967 p 106–119
(M-7375) Available from Natl. Lending Library, Boston Spa, Engl.

An algorithm, based on optimal interpolation, is presented for analyzing the fields of meteorological elements for the grid points of an arbitrary regular network in the northern hemisphere. Interpolation at the grid points is detailed. Cartesian coordinates are introduced into the calculation, and a binary sequence is used for computer analysis. Some programming details are included. M.W.R.

N68-35529 National Lending Library for Science and Technology, Boston Spa (England).
SECULAR OSCILLATIONS OF THE CIRCULATION OF THE ATMOSPHERE AND THEIR CONNECTION WITH SOLAR ACTIVITY
V. F. Loginov [1968] 10 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Geol. i Geogr., no. 12, Issue 2, 1966 p 115–118 In ENGLISH and RUSSIAN
(M-7383)

Frequency analyses were made of monthly means values of the index of solar activity and the forms of atmospheric circulation noted between 1900 and 1950; and amplitudes and phases of periods of circulation as well as Wolf numbers were obtained for each month. The following cycles were considered to be characteristic of the forms of atmospheric circulation: 3.7, 5.6, 7.9, 10.5, 14.5, 18.4, and 21.4 years. Lengths of cycles were identical for both atmospheric circulation forms and Wolf numbers, from which it was concluded that solar activity controls atmospheric circulation. M.W.R.

N68-35530 National Lending Library for Science and Technology, Boston Spa (England).

SOME FEATURES OF AN OPERATIONAL METHOD OF MONTHLY WEATHER FORECASTS

S. T. Pagava [1968] 26 p Transl. into ENGLISH from Gidromet. Nauo.-Issled. Cent., v. 10, 1967 p 3–17 In ENGLISH and RUSSIAN

(M-7396) Available from Natl. Lending Library, Boston Spa, Engl.

Methods of forecasting the sign of the monthly anomaly of air temperature for European USSR and western Siberia were analyzed for the period between July 1941 and December 1965, and various changes in measurement techniques are noted in terms of successful predictions. Factors influencing the quality of monthly weather forecasts are discussed in terms of trends within natural synoptic seasons, thoroughness of data obtained, and experience of the forecaster. Examples of forecasts made for various months during 1965 are included to indicate the accuracy of a currently used operational predictive technique, and these examples show the importance in rhythms and disruptions in making very long range monthly weather forecasts by the synoptic method. A four-stage analog is presented that permits a weather forecast for the USSR for a single year and, sometimes, two or three years. M.W.R.

N68-35585 National Lending Library for Science and Technology, Boston Spa (England).

THE DURATION AND DISTRIBUTION OF ANOMALIES IN THE TEMPERATURE ON THE OCEAN SURFACE

V. S. Nazarov [1968] 7 p ref Transl. into ENGLISH from Okeanologiya (Moscow), no. 8, 1968 p 23–25 In ENGLISH and RUSSIAN

(M-7374) Available from Natl. Lending Library, Boston Spa, Engl.

Measurements made by weather ships between 1948 and 1959 as well as data accumulated by some coastal stations were studied to determine the duration and distribution of ocean surface temperature anomalies. There appeared to be a correspondence between duration of the anomalies and the dimensions of the regions in which they occurred. Anomalies lasting 3 to 6 days occurred in regions of atmospheric anticyclones and depressions, while anomalies that lasted about a month occurred in the separate circulations of particular oceans. Seasonal anomalies were found in the surface temperature for the entire northern or southern hemisphere, and some anomalies occurred in all the oceans simultaneously. The latter, which lasted for more than a season, are considered to result from periodic changes of incoming heat from the sun; and their duration was usually 7 to 18 months. M.W.R.

N68-35579# Weather Squadron (15th), Detachment 13, Robins AFB, Ga.

TERMINAL FORECAST REFERENCE FILE

Donald N. Seay Mar. 1968 56 p

(AD-672815)

The Terminal Forecast Reference File is a complete revision of the previous TFRF for Robins. Author (TAB)

N68-35621 National Lending Library for Science and Technology, Boston Spa (England).

SPECIAL FEATURES OF THE DEVELOPMENT OF ATMOSPHERIC PROCESSES IN HOMOGENEOUS CIRCULATION PERIODS IN JUNE–AUGUST AND A METHOD FOR MAKING DETAILED LONG RANGE WEATHER FORECASTS FOR THIS PERIOD

N. D. Vinogradov [1968] 33 p refs Transl. into ENGLISH from Tr. Arkticheskogo i Antarkt. Nauchn.-Issled. Inst. (Leningrad), no. 275, 1967 p 95–112 In ENGLISH and RUSSIAN

(M-7398) Available from Natl. Lending Library, Boston Spa, Engl.

Long-range weather forecasts in the polar regions of the northern hemisphere were considered, as were special features of the development of atmospheric processes in homogeneous circulation periods (HCP) during June to August. Data collected between 1900 and 1962 were used, and analyses indicated that these forecasts based on probable location of pressure fields during an HCP were more accurate than conventional climatological charts. M.W.R.

N68-35674 National Lending Library for Science and Technology, Boston Spa (England).

LONG RANGE FORECASTING OF PRECIPITATION IN MAY

D. A. Drogajcev [1968] 55 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Cent. SSSR. Gidromet. (USSR), no. 12, 1968 p 19–44 In ENGLISH and RUSSIAN

(M-7413) Available from Natl. Lending Library, Boston Spa, Engl.

Efforts were undertaken to determine the conditions under which May precipitation is above, about, or below normal for the main agricultural regions in the south and central belts of the European U.S.S.R., and to develop a method of forecasting such precipitation over the whole territory. Calculations were made of the specific dimensions of the areas with precipitation above normal (> 120%), about normal (80% to 120%), and below normal (< 80%) for May of each year from 1891 through 1965. Fluctuations in May precipitation during solar activity cycles are analyzed, and the relationship between such precipitation and sharp fluctuations in solar activity and indices of atmospheric circulation are assessed. The forecasting significance of period-to-period pulses in the rise and fall of the geopotential is discussed. Six unrelated factors for April forecasting of May precipitation are listed as phase in solar cycle, pulse in solar activity, zonal index, 500 mb positive pulse in January, 500 mb negative pulse in February and 500 mb positive pulse in October–March. It is noted that the methods are more appropriate for forecasting precipitation distribution in a territory along a parallel than along a meridian. M.G.J.

N68-35789 National Lending Library for Science and Technology, Boston Spa (England).

ON THE USE OF CERTAIN INDICES FOR FORECASTING THUNDERSTORMS

A. V. Fateev 5 Sep. 1968 9 p Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 2, 1968 p 55–59 In RUSSIAN and ENGLISH

(M-550) Available from Natl. Lending Library, Boston Spa, Engl.

An index A is suggested and calculated by the inclusion of the dew point depression at the 600 mb level. An equation is derived in which the first term represents atmospheric stability in the 850, 700, 600, and 500 mb layers. The total dew point depression for the four surfaces represents the relative humidity in the layer where cumulus clouds originate and develop. A comparison is drawn with the Whiting and Slavin indices, in which the humidity at the 700 mb level is taken as its mean value in the 850 to 500 mb layer. The relationship between the values of the dew point depression at the 700 mb level and in the 850 to 500 mb layer is graphed, based on data for 10 stations in the northwest of the European U.S.S.R. for June–August 1966. The dependence of index A on the mean relative humidity ($\bar{R}$) in the 850 to 500 mb layer was determined, and the plot depicts a clear relationship between A and $\bar{R}$. Data on the frequency of thunderstorms for different values of A indicate that cumulonimbus clouds and thunderstorms are noted in more than 90% of the cases when $A \geq 0$. Methods of forecasting thunderstorms are explained in detail. It was found that the accuracy of the forecasts with A is better than with the other two indices. M.G.J.

N68-35809 National Lending Library for Science and Technology, Boston Spa (England).
FRONTS IN THE HUMIDITY FIELD
A. I. Samojlov [1968] 26 p ref Transl. into ENGLISH from Tr. Nauchn.-Issled Cent. SSSR. Gidromet (USSR), no. 13, 1967 p 60–73 In ENGLISH and RUSSIAN
(M-7382) Available from Natl. Lending Library, Boston Spa, Engl.

Consideration is given to the possibility of using humidities for analyzing fronts aloft, using the dew point as the characteristic of the humidity. It is pointed out that the dew point at a center can change by 10°C or more in 12 hours. Changes at 700 and 500 mb are greater than at 850 mb, and they are larger at dry centers than moist. The mean vertical dew point gradient for the three surface layers is listed for various places in the U.S.S.R. Vertical velocities are deduced from the dew points for both descending and ascending motions. Some general features of the surface humidity distribution are noted, and the evolution of the dew point field during the formation of a depression is discussed and depicted. Tabulated data on the mean values (from 200 cases) of several elements in temperature zones and dew point contrasts indicate that the dew point contrasts are usually greater than those of temperature. It is concluded that dew points significantly assist in recognizing the frontal positions, particularly at 700 and 500 mb. M.G.J.

N68-35995 National Lending Library for Science and Technology, Boston Spa (England).
ON THE QUESTION OF FORECASTING TRAJECTORIES OF CYCLONES DURING AN ELEMENTARY SYNOPTIC PROCESS
A. I. Ragozin [1968] 17 p refs Transl. into ENGLISH from Tr. Arkticheskogo i Antarkt. Nauchn.-Issled. Inst. (Leningrad), no. 275, 1967 p 239–248 In ENGLISH and RUSSIAN
(M-7391) Available from Natl. Lending Library, Boston Spa, Engl.

Succession of synoptic processes with a long delay is used to forecast the movement of pressure systems and determine trajectories of cyclones during an elementary synoptic process. The principle of succession, based on the assumption that each synoptic process originates in preceding processes, was used to forecast pressure systems within a 24-hr period as well as with large-circulation methods for long-range weather forecasting in the Arctic. Data were taken for autumn processes that occurred between 1948 and 1956, with partial use made of data accumulated through 1963; and more complete analysis was made of those processes that occurred at least five times during the period. Predominant trajectories of cyclones were tabulated, and reliability of these data were tested by comparison with charts relating to localization of pressure fields over a long period, as for the years between 1941 and 1951. Some indications of the speed of movement and the evolution of cyclones are included that are based on the role of the adiabatic temperature changes in the formation of the contour and thickness fields in the troposphere. M.W.R.

N68-35996 National Lending Library for Science and Technology, Boston Spa (England).
LONG RANGE SYNOPTICS IN THE LAST 50 YEARS
N. A. Aristov and L. I. Bljumina [1968] 15 p Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Gidromet. (SSSR), no. 12, 1968 p 3–11
(M-7407)

A chronological review of long range weather forecasting by the synoptic method is presented in terms of Soviet efforts since 1915. Based on the hypothesis that weather in a given region reflects atmospheric action in a larger area, the synoptic method predicts future conditions on the basis of events in previous synoptic seasons. Processes developing as anticyclones, macroprocesses lasting about 30 days, and the rhythmical nature of synoptic processes are mentioned. The transition to numerical forecasting methods and the calculation of geopotentials are noted, along with development of statistical weather forecasting and other currently used methods. M.W.R.

N68-36006 National Lending Library for Science and Technology, Boston Spa (England).
A STUDY OF THE SPECIAL FEATURES OF THE MODIFICATION OF FORMS OF CIRCULATION WITHIN MONTHS APPLIED TO MAKING DETAILED FORECASTS FOR OCTOBER AND NOVEMBER
V. S. Ragozina [1968] 42 p refs Transl. into ENGLISH from Arkticheskogo i Antarkt. Nauchn.-Issled. Inst. (Leningrad), no. 275, 1967 p 129–155 In ENGLISH and RUSSIAN
(M-7408) Available from Natl. Lending Library, Boston Spa, Engl.

A method is presented for studying relationships in meteorological parameters and the special features that modify the forms of circulation within certain periods in the polar regions. Specifically, these studies were aimed at improving overall weather forecasts and presenting more details for phenomena that might occur during October and November. The processes that occur during these two months were divided into homogeneous circulation periods (HCP) rather than calendar time segments in order to establish some patterns useful to weather forecasting. Hemispheric influences, background circulation, anomalies and large-scale processes, and other phenomena are considered. Mean pressure charts were drawn from HCP's that were distinguished between 1939 and 1961, and development of processes during October and November was considered in detail. M.W.R.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-34882*# Franklin Inst., Philadelphia, Pa. Research Labs.
MAN-COMPUTER ROLE IN SPACE NAVIGATION AND GUIDANCE Final Report
Eugene Farber, Lloyd P. Crumley (GE), and Leo Spiegel (GE) 19 Feb. 1968 172 p refs
(Contract NAS12-128)
(NASA-CR-86098; TR-1-204) CFSTI: HC $3.00/MF $0.65 CSCL 17G

This study established the function of a human crew in autonomous navigation and guidance in future, deep-space, manned missions and assessed the implications of such functions for navigation and guidance hardware requirements. A program incorporating the following seven major task areas was developed: mission definition, navigation requirements, error sensitivity analysis, the conceptualization of a minimum manual system for navigation, a state-of-the-art review of navigation sensors, the conceptualization of automated aids to manual navigation, and a study of navigation display requirements. The mission selected for study was the Ares Mars Mission, a 630-day journey with a Venus flyby on the return leg. Navigation and guidance requirements and procedures for four mission phases were selected for detailed study: Earth orbit determination and adjustment; injection into Mars trajectory; post and terminal (midcourse) adjustments; and entry into Mars orbit. Author

N68-35107# Pickard and Burns Electronics, Waltham, Mass.
VLF AIRBORNE SYSTEM NOISE AND ANTENNA STUDY AND STUDY OF LANE IDENTIFICATION FOR OMEGA, VOLUME 1 Final Report
Richard H. Woodward, Morton F. Spears, Bernard Ambroseno, and David Davidson (Westinghouse Elec. Corp.) 4 Mar. 1968 135 p
(Contract FA-65-WA-1298)
(P&B-PUB-979-8; SRDS-RD-68-17)

The immediate purposes of the program are to determine the effect of precipitation static on the reception in aircraft of very-low-frequency signals, to devise a method for reducing the effect to a tolerable level and to collect data on Omega, and ultimately to determine the feasibility of Omega for air navigation. Three types of airborne antennas have been investigated. The long-wire antenna was abandoned early in the program because it was not notably superior electrically and was aerodynamically unsuitable. Each of three 24-inch blade antennas performed well except in wet weather. Two pairs of crossed-loop antennas demonstrated least sensitivity to precipitation static and rain. These are preferable aerodynamically for high speed aircraft but for navigation systems require complicated switching. Locations of the blade and crossed-loop antennas on the aircraft are not critical. Plans to collect data in subsonic and supersonic jet aircraft ultimately had to be abandoned because appropriate aircraft could not be provided. Phase difference and field-intensity data were collected over periods of approximately three days and three nights in winter and summer at six widely scattered monitor stations (airports) in South America and six in North America. This information is needed for the accurate prediction of Omega sky-wave corrections, hyperbolic lines of position and lane identification. For the study of the propagation of Omega signals at relatively short range from the transmitting station, phase difference of Omega signals relative to a stable reference source were measured in a small truck travelling along the highways out to a range of 600 kilometers from the Forestport station. Author

N68-35409# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALGORITHM OF MULTIPLE TARGET AUTOMATIC TRACKING USING A SHIPBORNE DIGITAL COMPUTER [ALGORITM AVTOSOPROVOZHDENIYA MNOGIKH TSELEY NA SUDOVOY TSIFROVOY VYCHISLITEL'NOY MASHINE]
I. V. Apanin 24 Jan. 1968 15 p refs Transl. into ENGLISH from the publ. "Leningrad. Tsentral'nyy Nauchno-issledovatel'skiy Institut Morskogo Flota. Trudy" Leningrad, no. 73, 1966 p 77-83
(FTD-MT-24-383-67; AD-672712)

A method of automatic tracking of multiple targets at sea with the aid of a digital computer is reviewed and a possible algorithm for such tracking is described. Author (TAB)

N68-35477# Naval Research Lab., Washington, D. C.
LANE IDENTIFICATION IN THE OMEGA SYSTEM
J. W. Brogden and K. Luken 2 May 1968 91 p
(NRL-MEMO-1876; IR-2; AD-672587)

Omega is a long-range, very -low-frequency hyperbolic radio navigation system for use by aircraft, ships and submarines. Coverage for the entire earth will be provided by eight transmitters operating at the base frequency of 10.2 kilohertz (khz). One of the characteristics of the system is that phase information repeats itself from one hyperbolic lane to the next. The first step in resolving this lane ambiguity is the use of 13.6 and 10.2 khz transmissions which produce a 3.4 khz difference frequency having a lane width of three times the 10.2 khz lane or approximately 24 miles. The second step is to identify the correct 3.4 khz lane, using 11-1/3 khz transmissions with the 10.2 khz transmissions, the 1133-1/3 hertz (hz) difference frequency will again increase the periods between ambiguity by a factor of three to approximately 72 miles, on the basis of repeatability, the data show that with proper propagation corrections the 3.4 khz and 1133-1/3 hz difference frequencies can resolve 10.2 khz lanes with the 72 miles for more than 95 percent of the time. Author (TAB)

N68-35511 National Lending Library for Science and Technology, Boston Spa (England).
THE DETERMINATION OF VISIBILITY FROM HIGH INTENSITY LIGHTS
S. M. Aleksanjanc, Ju. G. Konovalov, and V. I. Unukov Mar. 1968 13 p refs Transl. into ENGLISH from Met. Gidr. (Leningrad), no. 8, 1967 p 76-81 In ENGLISH and RUSSIAN
(M-7393) Available from Natl. Lending Library, Boston Spa, Engl.

Determination of visual range (RVR) from high intensity lighting (HIL) at civilian airports is discussed, and use of a computerized simulation is considered. The relationship between threshold of light sensitivity of the eye and the brightness background is noted. Some curves for calculating the runway visual range are included, and comparisons are presented for actual visual ranges with calculated values of RVR for the HIL. M.W.R.

N68-35758*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
ANALYSIS OF ERROR PROPAGATION IN AIRCRAFT INERTIAL NAVIGATION SYSTEMS
John C. Ruth Jul. 1968 31 p refs
(Grant NGR-22-009-229)
(NASA-CR-97074; RE-43) CFSTI: HC $3.00/MF $0.65 CSCL 17G

An analysis is presented of the dominant sources of error in three different aircraft inertial navigation systems. The three systems studied, all of which are undamped, are: 1) A local-level, free azimuth system 2) A space-stabilized system 3) A strap-down system; Linearized mathematical error models describe each system, while the use of a digital computer is necessary to perform the required simulations. Various flight paths and maneuvers are simulated, and the position errors are analyzed on the basis of the sources contributing to the error. It is assumed that the sources of the errors are contained in the instruments mounted in each system. The error models representing the gyros and accelerometers for each system are described in the paper. The effects of gravitational attraction, inertial acceleration, linear velocity, angular velocity, and angular acceleration on the position error of the systems are presented and analyzed. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-34833*# Nuclear Utility Services, Inc., Washington, D. C. Environmental Safeguards Div.
COMPARISON OF NUCLEAR AND EXPLOSIVE DESTRUCT CONCEPTS FOR NUCLEAR ROCKET ENGINES
Albert W. De Agazio May 1968 59 p refs
(Contract SNPC-6)
(NASA-CR-96699; NUS-277) CFSTI: HC $3.00/MF $0.65 CSCL 21F

In the event of premature re-entry of a nuclear rocket engine, it would probably be desirable to fragment the reactor core to minimize the radiation effects on the affected population. The

nuclear stage can be equipped with chemical high explosives to destroy the core, or the reactor can be designed so that a rapid reactivity insertion will cause core fragmentation. The differences in fragmentation characteristics from these two methods are defined, and the consequent biological interactions resulting from the dispersal of radioactive particles are investigated. NSA

N68-35068*# Aerojet-General Corp., Azusa, Calif. Von Karman Center.
SNAP 8 ELECTRICAL GENERATING SYSTEM DEVELOPMENT PROGRAM Semiannual Progress Report, 1 Jan–30 Jun. 1966
Aug. 1968 222 p refs
(Contract NAS5-417)
(NASA-CR-72103; Rept.-3233) CFSTI: HC $3.00/MF $0.65 CSCL 18N

SNAP-8 is a turboelectric, nuclear, space power conversion system using a mercury Rankine cycle. The system incorporates three liquid metal loops. Sodium-potassium (NaK) in a primary loop is heated in a reactor, and, in turn heats mercury in a heat exchanger. The mercury vapor, in the second loop, expands through a turbine; it is then condensed, and pumped back through the boiler. A third loop, also containing NaK, transfers the heat from the mercury to a radiator where it is rejected to space. The fourth loop contains a polyphenyl ether that lubricates the bearings of the main rotating components and provides necessary cooling for the alternator, electric motors, and controls. This report discusses the development progress of the power conversion system, including turbine-alternator assembly, pump-motor assemblies, boiler, condenser, and electrical controls. Author

N68-35073*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF SMALL WATER-GRAPHITE NUCLEAR ROCKET STAGES WITH CHEMICAL UPPER STAGES FOR UNMANNED MISSIONS
M. Ray Clark, Gary D. Sagerman, and Gerald P. Lahti Washington Sep. 1968 58 p refs
(NASA-TN-D-4827) CFSTI: HC $3.00/MF $0.65 CSCL 21F

Payload performance and the radiation environment characteristics of this small reactor type (200 to 600 MW power) in a nuclear upper stage are considered. Payload dose criteria indicate that any shielding requirement would be based on propellant heating considerations. Several approaches to propellant heating, including subcooled or slush hydrogen propellant and shielding, are compared. Potential performance gains are outlined for the Saturn 1B and 260-inch solid launch vehicles when employing orbital nuclear start engine firing, optimum nuclear thrust, and subcooled hydrogen propellant. Payload sensitivity to the nuclear-stage jettison weight and to the shielding approach to propellant heating is illustrated. Author

N68-35153*# General Electric Co., Cincinnati, Ohio.
CB-1ZR SODIUM THERMAL CONVECTION LOOP
E. E. Hoffman and J. Holowach Washington NASA Sep. 1968 135 p refs
(Contract NAS3-2547)
(NASA-CR-1097; R67SD3014) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A sodium thermal convection loop constructed of Cb-1Zr was tested for 1000 hours at temperatures up to 2380°F. The purpose of the experiment was to evaluate several of the components selected for subsequent use in a two-loop Cb-1Zr facility in which liquid sodium was to circulate in a primary loop and potassium was to circulate in a two-phase secondary loop. In general, the components tested performed satisfactorily. No significant corrosion of the Cb-1Zr by the high temperature sodium was observed and the level of the vacuum environment maintained during the experiment prevented deleterious contamination of the Cb-1Zr tubing. The results of chemical analysis indicated a migration of the oxygen in the Cb-1Zr tubing from the hottest regions of the loop to the cooler regions. Author

N68-35483# Naval Research Lab., Washington, D. C. Nuclear Physics Div.
REACTOR UTILIZATION IN SUPPORT OF RESEARCH AND TECHNOLOGY
Charles V. Strain 21 Jun. 1968 24 p refs
(NRL-6709; AD-672891)

The radiations generated in a nuclear reactor are useful not only in nuclear physics research but also in many nonnuclear fields of science and technology. A review of present and potential applications of the NRL 1-MW reactor is undertaken with the purpose of encouraging additional utilization of this facility. Neutron activation analysis, a technique capable of assaying very small amounts of many of the chemical elements, is widely used, with examples of its use ranging from the analysis of trace impurities in highly purified materials to law-enforcement purposes. The sensitivities of the neutron activation technique, expressed as the smallest measurable amount of each chemical element, are included. Other techniques discussed include the measurement of magnetic and crystallographic structure by neutron diffraction, inert and radioactive tracer techniques, the production and use of radioactive sources, radiation effects, and thermal-neutron radiography. Author (TAB)

N68-35576# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
REVIEW OF BURNOUT STUDIES IN FREON AND DESCRIPTION OF A FREON LOOP
J. Price Feb. 1968 19 p refs
(AAEC/TM-441)

The need for simulation in studies of burnout or critical heat flux for application to nuclear reactor design is outlined. The available literature on the suitability of Freon as a model fluid for water is reviewed and discussed. A brief description is given of a Freon loop currently under construction at the A.A.E.C. Research Establishment. Author (NSA)

N68-35614# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung.
APPLICATION OF THE PLUTONIUM STORAGE PRINCIPLE ON THE SPHERICAL PILE HIGH TEMPERATURE REACTOR [ANWENDUNG DES PLUTONIUMSPEICHERPRINZIPS AUF DEN KUGELHAUFENHOCHTEMPERATURREAKTOR]
Tuncay Babac Jul. 1968 87 p refs In GERMAN
(JUL-542-RG) CFSTI: HC $3.00/MF $0.65

Developed is a computer program for calculating the performance of pebble bed reactors with uranium-plutonium cycle. Reactor systems with one or multiple uranium cores are evaluated for possible plutonium recovery and reintroduction into the reactor cycle. Optimal processes at low initial uranium^{235} volume are studied for economic aspects. Transl. by G.G.

N68-35693# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
EXPLORATION OF THE PROBLEMS ASSOCIATED WITH THE NEUTRON IRRADIATION OF SAMPLES UNDER HIGH HYDROSTATIC PRESSURES
G. L. Kulcinski May 1968 95 p refs
(Contract AT(45-1)-1830)
(BNWL-613) CFSTI: HC $3.00/MF $0.65

Problems associated with the design of equipment to generate high hydrostatic pressures on samples which are simultaneously irradiated to a neutron fluence of 10^{18} nvt are discussed. Basically, the capsule incorporates a clamping type method of maintaining

pressure in conjunction with the tapered cylinder pressure support concept. Pressure stability and calibration is obtained by the use of an alkali halide, immersed with the sample in a liquid metal pressure transmitting media. The liquid metal is contained by use of a Bridgman seal arrangement. The overall dimension of such a cell could be approximately 2.75 in. in dia approximately 6 in. long, if it is constructed out of high strength, low alloy steel. This cell could accommodate a sample of slightly less than 0.25 in. in dia and 0.5 in. long which can be subjected to approximately 20 kbars of pressure while it is inside a nuclear reactor. NSA

N68-35699# General Electric Co., Philadelphia, Pa. Missile and Space Div.
SNAP-27 Quarterly Report, 1 Jan.–31 Mar. 1968
31 Mar. 1968 146 p refs
(Contract AT(30-1)-3535)
(GEMS-400; QR-10) CFSTI: HC$3.00/MF$0.65

Accomplishments, schedules, liaison, and program integration of SNAP-27 into the total ALSEP/Apollo program are presented. Progress made on the Integrated Power Unit is reported including generator assembly, fuel capsule, and support equipment. Design status, thermal and structural analysis, materials procurement progress concerning the graphite LM fuel cask are summarized. The safety programs are outlined. NSA

N68-35714# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
REACTIVITY MEASUREMENTS IN A NUCLEAR REACTOR [LA MESURE DE LA REACTIVITE DANS UN REACTEUR NUCLEAIRE]
Jean-Claude Amblard Feb. 1968 25 p In FRENCH
(CEA-R-3375)

A mathematical model of a multifuel nuclear reactor is described. The principle of the continuous measurement of reactivity using the reactimeter is derived. As an example, the Pagels lattices associated with the reactimeter designed for Rapsodie are calculated. A reduction method for groups of delayed neutrons which govern the dynamic operation of the reactor is given. This problem has no rigorous solutions but with a relatively small error in reactivity measurement, the number of families can be reduced to three. Author (NSA)

N68-35727# Phillips Petroleum Co., Idaho Falls, Idaho.
RELAP 2: A DIGITAL PROGRAM FOR REACTOR BLOWDOWN AND POWER EXCURSION ANALYSIS
K. V. Moore and W. H. Rettig Mar. 1968 75 p refs
(Contract AT(10-1)-205)
(IDO-17263) CFSTI: HC$3.00/MF$0.65

RELAP2 is a FORTRAN IV digital program which calculates flow, mass inventories, temperatures, pressures, reactivities, and transient power for the primary system of a water reactor during a reactivity or a loss-of-coolant accident. Although retaining the simplified geometry (three volumes plus a core region) of the FLASH and RELAPSE programs, many improvements and extensions have been made. The geometry can be made to approximate either a pressurized or a boiling water reactor system. The core is treated as a two-point model for power generation, heat transfer, and reactivity feedbacks and as a one-point model for the reactor kinetics, pressure balances, and flow balances. RELAP2 is in production status on the CDC 6600, CDC 1604, IBM 7044, and Univac 1108. This version of the program has demonstrated more flexibility, greater stability, improved reliability, and a speed increase of over a factor of two when compared to RELAPSE. Author (NSA)

N68-35738# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
NUMERICAL INVESTIGATION OF THE METHODS OF CALCULATION OF CRITICALITY AND BREEDING RATIO FOR REACTORS WITH CYLINDRICAL GEOMETRY AND PARTIALLY INSERTED CONTROL RODS [NUMERISCHE UNTERSUCHUNGEN ZU METHODEN DER KRITIKALITAETS- UND BRUTRATENBERECHNUNG FUER REAKTOREN MIT ZYLINDERGEOMETRIE UND TEILWEISE EINGEFAHRENEN REGELSTAEBEN]
W. Schwetje Mar. 1968 33 p refs In GERMAN
(KFK-741; EUR-3723)

Calculations of eigenvalues in R-θ and R-Z coordinates are tabulated as a function of geometric variations for cylindrical reactors; sample geometries are shown. The calculations are performed by sectioning the control rod into rings of graduated thickness. Use of this method for integral approximations is discussed. Calculations which determine the effects of control rods on breeding rate are tabulated. NSA

N68-35740# Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Forschungsreaktoren.
CALCULATION OF THE INTERMITTENT MICROSCOPIC TEMPERATURE DISTRIBUTION IN MATRIX FUEL ELEMENTS WITH HELP OF AN IMPLICIT DIFFERENCE METHOD [BERECHNUNG DER INSTATIONAEREN MIKROSKOPISCHEN TEMPERATUREVERTEILUNG IN MATRIXBRENNSTOFFELEMENTEN MIT HILFE EINES IMPLIZITEN DIFFERENZENVERFAHRENS]
Dieter Biedermann May 1968 106 p refs In GERMAN
(JUL-526-RE)

A digital computer program and an implicit difference method are used for the approximate solution of the transient heat transfer equation. For the weight factors contained in the mathematical program, optimum values are determined regarding stability behavior and computational accuracy. The program is suitable for calculating one-dimensional transient and stable heat transfer processes with temperature-dependent material values in cartesian, cylindrical and spherical coordinates. The calculations are performed for graphite and beryllium oxide as matrix materials and with uranium carbide and uranium dioxide as fuel materials. Transl. by K.W.

N68-35741# Douglas United Nuclear, Inc., Richland, Wash.
MATHEMATICAL BASIS OF COMPUTER CODE RIBD
R. O. Gumprecht 17 Jun. 1968 24 p refs
(Contract AT(45-1)-1857)
(DUN-4136) CFSTI: HC$3.00/MF$0.65

A brief description of the operation and mathematical basis of the computer code RIBD (Radio Isotope Buildup and Decay) is given. The code has been in use at Hanford for several years in analyzing the fission product content of irradiated reactor fuel in terms of potential biological hazards and heating effects accompanying radioactive decay. Author (NSA)

N68-35755# Los Alamos Scientific Lab., N. Mex.
ENVIRONMENTAL EFFECTS OF THE KIWI-TNT EFFLUENT: A REVIEW AND EVALUATION
R. V. Fultyn Apr. 1968 68 p refs
(Contract W-7405-ENG-36)
(LA-3449) CFSTI: HC$3.00/MF$0.65

The Kiwi Transient Nuclear Test (Kiwi-TNT) was a controlled excursion in which reactivity was inserted into a nuclear rocket engine prototype fast enough to vaporize a significant portion of the reactor core. The test studied the neutronic behavior of the reactor and the environmental effects of the radioactive materials released. The determination of environmental effects is described. The test was conducted at the Nuclear Rocket Development Station, Jackass Flats, Nevada, on January 12, 1965, at 1085 PST. The course of the effluent cloud was tracked by aircraft from the U. S. Public Health Service and EG&G. From 5 to 20% of the reactor core was vaporized, with approximately 67% of the products from about 3×10^{20} fissions released to the effluent cloud. Radiation effects from the cloud passage were less than predicted in the pretest

safety evaluation report. The maximum off-site, integrated, whole-body exposure was 5.7 mRAD about 15 miles from the test point. No fresh fission products were detected in any of the milk samples. Author (NSA)

N68-35818# Gulf General Atomic, San Diego, Calif.
COATING CONTAMINATION IN FUEL PARTICLES
E. Selleck 15 May 1968 29 p refs
(Contract AF(04-3)-167)
(GAMD-8325) CFSTI: HC$3.00/MF$0.65

An evaluation of uranium contamination in pyrolytic carbon and SiC coatings on UC_2 and $(Th,U)C_2$ fuel pellets is presented. The effects of coating temperatures on contamination are described. Analysis of annealing time effects on barium and strontium release is discussed. NSA

N68-35826*# United Aircraft Corp., East Hartford, Conn.
OPTICAL ABSORPTION AND FLUORESCENCE IN FUSED SILICA DURING TRIGA PULSE IRRADIATION
R. Gagosz and J. Waters Washington NASA Sep. 1968 43 p refs
(Contract NASw-847)
(NASA-CR-1191; G-910485-3) CFSTI: HC $3.00/MF $0.65 CSCL 18J

An experimental investigation was conducted at the Mark II pulse reactor to determine the spectral transmission characteristics during and after an irradiation pulse and to determine the cause of the apparent increase in transmission during the pulse and the apparent decrease of trnasmission after the pulse which had been observed in the previous test program. A total of 91 experiments were performed on six specimens at a range of temperatures from 500 to 900C. Transmission measurements were made at two wavelengths, 2150 and 3021 Angstroms. Corning 7940 fused silica specimens in a corner cube configuration were mounted next to the reactor core face at the internal end of a reactor beam port. Peak neutron and gamma fluxes obtained from this reactor were approximately $5=4 \times 10^{15}$ n/cm^2-sec and 6.1×10^7 R/sec, respectively. Neutron and gamma doses associated with these pulses were 2.3×10^{-14} n/cm^2 and 2.0×10^6R, respectively. In addition to the transmittance tests, bypass and optical instrumentation tests were conducted to examine the influence of the optical instrumentation tests were conducted to examine the influence of the optical alignment parameters upon system operation. Fluorescent test were also conducted to obtain an applicable correction to the transmittance runs. Author

N68-35845# Kerforschungsanlage, Juelich (West Germany). Zentralinst. fuer Reaktorexperimente.
NONDESTRUCTIVE DETERMINATION OF THE NUCLEAR FUEL CONTENT OR THE BURN-UP IN FUEL SAMPLES OR REACTOR FUEL ELEMENTS [DIE ZERSTOERUNGSFREIE BESTIMMUNG DES KERNBRENNSTOFFGEHALTES ODER DES ABBRANDES AN BRENNSTOFFPROBEN ODER REAKTORBRENNELEMENTENT]
E. Leopold Dieck Jun. 1968 95 p refs In GERMAN
(JUL-529-RX) CFSTI: HC$3.00/MF$0.65

Coated uranium and thorium fuel particles were exposed to thermal neutron flux of varying duration and intensity. Differentiating spectra of the irradiated materials were obtained with NaJ(Tl) crystal gamma detectors for comparison of fission products and burn up stage. Transl. by G.G.

N68-35858# Gulf General Atomic, Inc., San Diego, Calif.
BARIUM DIFFUSION IN PYROLYTIC CARBON AND SILICON CARBIDE
E. Selleck 15 May 1968 12 p refs
(Contract AT(04-3)-167)
(GAMD-8326) CFSTI: HC$3.00/MF$0.65

A method is given which permits the examination of diffusion profiles of specific fission products across typical uncontaminated coating materials. Graphite disks were coated with various materials, loaded into crucibles, activated in TRIGA, annealed at 1400°C, and unloaded. Analysis by gamma spectrometry showed the barium activity and results are graphed. The diffusion profiles of barium-140 in the pyrolytic carbon and silicon carbide coating are given. NSA

N68-35900# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente.
THE STABILITY OF RIGID FEEDBACK CONTROL SYSTEMS WITHOUT COMPENSATION IN AN EXAMPLE OF A STEAM COOLED REACTOR [DIE STABILITAET VON STARR ZURUECKGEFUEHRTEN REGELSTRECKEN OHNE AUSGLEICH AM BEISPIEL DES DAMPFGEKUEHLTEN REAKTORS]
L. Krebs Dec. 1967 27 p refs In GERMAN
(KFK-656; EUR-3691.d)

The development of a calculational model for a steam cooled reactor system is discussed. Approximation methods for calculation of stability limits are developed; models with and without the dead time are considered. Time lag effects are analyzed; the importance of criticality factors is evaluated. Stability limits for a steam-cooled reactor coolant circuit are determined. NSA

N68-35916# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
TRACK: A COMPUTER PROGRAM FOR TRANSIENT AND STEADY STATE COUPLED FLUID FLOW AND HEAT CONDUCTION ANALYSIS
A. Y. Lee and Marshall D. Woods Jan. 1968 75 p refs
(WANL-TME-1736) CFSTI: HC$3.00/MF$0.65

A method of solution for transient or steady state analysis of a parallel channel flow system separated by heat generating solids is presented. The primary application is to perform a detailed thermal analysis of nuclear reactor components such as the reflector, the control mechanisms, and fuel cluster assemblies under various operating conditions. The method of solution may be applied to other heat transfer systems with or without internal heat generation such as heat exchange apparatus. The method employs one-dimensional, transient (or steady state) pipe flow analysis coupled with a heat conduction calculation in the solid body. The heat conduction calculation is included to determine the channel wall temperatures required to complete the hydrodynamic calculations and to provide detailed material temperature distributions. Thus, heat conduction effects between coolant channels are evaluated. The solid body geometry is general and the parallel channels may have different individual flow impedance and be arranged in any non-symmetrical pattern. TRACK, a digital computer program, was developed to perform the computations. It is written in FORTRAN IV language for the CDC-6600 computer. NSA

N68-35922# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorwerkstoffe.
RADIATION EFFECTS ON CORROSION AND STRENGTH OF BEO-MODERATOR ELEMENTS IN A THERMIC HIGH TEMPERATURE BREEDER REACTOR [UEBER DIE STRAHLENSCHAEDIGUNG DER FESTKEIT VON BEO-MODERATORELEMENTEN IN EINEM THERMISCHEN HOCHTEMPERATURBRUTREAKTOR]
F. E. Buresey Jun. 1968 17 p refs In GERMAN
(JUL-528-RW) CFSTI: HC$3.00/MF$0.65

The influence of grain growth, porosity, and He bubble growth on the fracture strength of BeO was studied assuming exposure to fast neutron doses of 10^{20} nvt. The BeO is to be used as a spherical moderator element in the core of a high temperature breeder reactor of 1000 MWe. The calculations indicate that the fracture strength decreases approximately 50% in case of an increase in grain size from 5 to 10μ. An increase in the porosity from 2 to 13% causes stress relaxation and results in an improvement of the fracture strength by approximately 20%. The He bubbles appear to have no effect on the fracture strength following a run through the core. Transl. by K.W.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-34817 Rutgers Univ., New Brunswick, N. J.
STATISTICAL DESIGN AND ANALYSIS OF SHAPE STUDIES
Ronald Davis Snee (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-14762

The size and general shape of certain types of near oval or ellipsoidal objects can be characterized by appropriately designed measurements: the length, measured along the major axis, and the maximum and minimum diameters measured at selected positions along the major axis. Four methods of analysis and interpretation of data collected in size and shape studies are presented. Methods 1 and 2 are univariate analyses which use the analysis of variance. The ability to test the significance of certain two and three-way interactions, using the analysis of variance, permits an assessment of the statistical significance of the designed experimental effects on the configuration or form. The reconstruction of the average objects for the treatments can adequately reveal the nature of the experimental effects on configuration. In situations where shape is described by diameter-to-length ratios, the nature of the experimental effects can be represented by a graphical presentation of the diameter-to-length ratio means. Methods 3 and 4 are multivariate analyses which analyze all data simultaneously taking advantage of the correlations among the measurements. In Method 3, principal component analysis is used to select certain linear combinations of the measurements. In Method 4, discriminant analysis provides an overall single test of significance for the experimental effects on the configuration. It is concluded that while the multivariate methods are not subject to all the assumptions underlying the analysis of variance, they are less flexible for the analysis of size and shape data from designed experiments. These procedures of design, analysis, and interpretation can be extended to other shape studies. Dissert. Abstr.

N68-34818 Texas Univ., Austin.
SURFACE WAVES ABOUT A THIN-WALLED ALUMINUM CYLINDER IN A WATER MEDIUM
Mark Vincent Mechler (Ph.D. Thesis) 1967 133 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-14867

This dissertation presents the results obtained in an experimental and theoretical study of acoustic waves propagating over the exterior surface of an air-filled, cylindrical aluminum shell immersed in water. The shell was excited by an acoustic line source located a short distance away from the shell's convex surface and with its axis parallel to that of the shell. The outside diameter of the shell was 5.475 in., and its length and wall thickness were 10 in. and 0.094 in., respectively. Frequencies used in tests ranged from 50 kHz to 200 kHz. Thus, the corresponding circumference to wavelength ratios, determined at the outside surface of the cylinder and for waves propagating in the water medium, ranged from 14.65 to 58.6. In one series of tests, the line source was energized by a sequence on three cycle, gated sinusoids. In a second series of tests, the line source was energized with continuous, sinusoidal power. Because the experiments were necessarily conducted with a cylinder and source of finite length, it was considered desirable to compute the polar patterns of the surface pressure predicted by theory. Comparison of the computed and measured results indicates that measurements made with the receiving line transducer are in approximate agreement with theory. Dissert. Abstr.

N68-34854# Cekmece Nuclear Research Center, Istanbul (Turkey).
A STUDY OF THE STRUCTURE CHANGE OF WATER BY MEASURING THE SOUND VELOCITY
Ertugrul Yazgan Jun. 1968 8 p refs
(CNAEM-58) CFSTI: HC $3.00/MF $0.65

The sound velocity has been measured in twice distilled water between 1-40°C with 0.5°C temperature intervals. The differences between the calculated velocities using a fifth degree polinom which was obtained by a computer and the measured velocities were plotted as a function of temperature. It was noticed that at some temperatures this curve does not have a random distribution character. Author

N68-34856 Syracuse Univ., N. Y.
SEARCH FOR AN ELECTRON-PROTON CHARGE DIFFERENCE BY CHARGE MEASUREMENTS ON A SMALL MACROSCOPIC BODY
Raymond Webster Stover (Ph.D. Thesis) 1967 193 p
Available from Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 67-12082

A new method for the investigation of the possible difference between the magnitudes of the electron and proton charge was developed, in which the net charge on a magnetically suspended iron spheroid is measured. An inequality of these charges would, in general, produce a net charge on the spheroid not expressible as an integral number of electron charges. A horizontal electric field is applied in a direction of weak magnetic restoring forces and the monopole force is determined by a null method, in which an auxilliary magnetic field balances the monopole force as the voltage polarity is reversed. Detection of the null displacement utilizes the shadow of the spheroid, focused on a photosensitive device. A comprehensive study of all other forces on the ball proportional to the electric field intensity, was necessary. The most important problems encountered were forces caused by fixed charges on the spheroid and electrode surfaces. Dissert. Abstr.

N68-34863 Syracuse Univ., N. Y.
THE CURRENT FORMALISM IN ASYMPTOTIC QUANTUM FIELD THEORY
James Glendenning Wray, Jr. (Ph.D. Thesis) 1967 142 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-12090

This work has served to develop a finite formulation of quantum field theory with the following results. 1) It is free of divergent expressions and of cut-offs. 2) Only physically defined parameters enter the theory such that there is no renormalization. 3) For the renormalizable theories a unique solution is specified in perturbation expansion. 4) For the nonrenormalizable theories it is

demonstrated that a finite unique solution exists in perturbation expansion to any prescribed order but this is possible only at the expense of introducing a number of parameters that increases with the order of perturbation. 5) In addition, the analogs of the interacting field and S_{op} representations as R and Φ-products of fields, respectively, are derived in a current representation.
Dissert. Abstr.

N68-34938 Brandeis Univ., Waltham, Mass.
CLASSICAL STATISTICAL MECHANICS OF THE HARD-CORE POTENTIAL
Martin Jacob Cooper (Ph.D. Thesis) 1967 75 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 67-16543

Difficulties associated with representing the strong short ranged forces between the particles of a many-body system are discussed. A method is described by which a more exact treatment of the N-body system becomes available without restricted domains or excluded volume regions provided that certain physical properties of the two-body scattering are retained. The method, an extended canonical point-transformation, is based on providing an equivalent non-singular Hamiltonian which is both Hermitian and Fourier analyzable. The price of such a transformation is the introduction of non-local velocity dependent interactions between the particles. This approach allows for an immediate means of analysis of the role of the hard-core interactions in a many-body system which may be treated by any of the conventional methods of statistical physics. Direct contact is made with the more usual expressions for a hard-sphere many-body system, and it is explicitly demonstrated that the real advantage of this canonical reformulation of the strong interactions in terms of an equivalent momentum dependent potential lies in allowing the repulsion to be treated in the same manner as any weak long ranged interaction. The role of the excluded volume regions in the condensation of a real fluid of weakly attractive particles is investigated. A description of the approach to equilibrium of a hard-sphere gas is obtained.
Dissert. Abstr.

N68-35026 New Mexico State Univ., University Park.
CONDITIONS FOR NON-RADIATION AND THEIR RELATIONSHIP TO CONSERVATION LAWS IN CLASSICAL FIELD THEORY
Jerry Butler Arnett (Ph.D. Thesis) 1967 71 p
Available from Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 67-12850

Goedecke's non-radiating charge-current distributions are used to evaluate the retarded electromagnetic vector and scalar potentials. The oscillating parts of these potentials are shown to vanish identically outside the distribution: these particular charge-current distributions, although in motion, have only static external fields. Several surface integrals which arise in connection with conservation laws in first-quantized field theory are considered. These integrals must be zero in order that the system be closed. It is shown that Goedecke's condition for non-radiation is sufficient to make all these integrals vanish, while the weaker necessary and sufficient condition for non-radiation makes all but one vanish.
Dissert. Abstr.

N68-35051 Michigan Univ., Ann Arbor.
ANALYTICAL METHODS IN THE THEORY OF NON-LINEAR OSCILLATIONS
Timothy Patrick Coffey (Ph.D. Thesis) 1967 234 p
Available from Univ. Microfilms: HC $10.60/Microfilm $3.05 Order No. 67-15606

Methods are developed for constructing approximate solutions of nonlinear differential equations which describe nearly periodic or nearly multiple periodic phenomena. The concern is primarily with systems of differential equations which can be generated from a Hamiltonian. The methods employed are, however, not restricted to Hamiltonian systems. A brief review of classical perturbation theory as developed by Poincaré is given. Following this a formal perturbation method is presented. This method was developed by Bogoliubov for generating asymptotic solutions of a system of differential equations which describe the motion of a dynamical system which is nearly periodic in a single phase. The Bogoliubov method is applied to a class of one dimensional Hamiltonian systems. For this one dimensional case it is demonstrated that the Bogoliubov method is equivalent to the classical perturbation theory of Poincaré The method is generalized to deal with systems which are nearly periodic in two phases. The nondegenerate and degenerate perturbation theories are applied to a class of Hamiltonian systems. It is shown that nondegenerate perturbation theory is equivalent to the classical perturbation theory of Poincaré.
Dissert. Abstr.

N68-35052 Michigan Univ., Ann Arbor.
A NEW EXPERIMENTAL TEST OF COULOMB'S LAW OF FORCE BETWEEN CHARGES
Gary Don Cochran (Ph.D. Thesis) 1967 227 p
Available from Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 67-15604

The exponent in Coulomb's law of force between point charges is investigated. In 1936, Plimpton and Lawton established a value for this exponent of $2(1 \pm 10^{-9})$. This experiment is analyzed and methods of refining the experiment are presented. Sophisticated voltage detection and data processing techniques are discussed which provide significant improvements in the experiment. The existence of spurious effects created difficulties in determining a new value for the exponent with the present experiment. These spurious effects are discussed and their origins are investigated experimentally. Because of these effects two values for the exponent are reported. The first is $2(1 \pm 2.3 \times 10^{-11})$ which represents a limit of error for the experiment, and the second is $2(1 + 4.6 \times 10^{-12})$ which represents our estimate of the 70% confidence interval. Theoretical calculations yield a new approximation to the charge distribution on a cubic conductor for the usual Coulomb inverse square law of force.
Dissert. Abstr.

N68-35054 Indiana Univ., Bloomington.
THE EFFLUVIAL THEORY OF ELECTRICITY
Roderick Weir Home (Ph.D. Thesis) 1967 289 p
Available from Univ. Microfilms: HC $13.05/Microfilm $3.75 Order No. 67-15107

An analysis is given of the structure and development of the effluvial theory of electricity during the first half of the eighteenth century. It is argued that, contrary to what has often been supposed, the theory was a genuine one in the sense that it played the same role in electrical science before 1750 as is played by any other theory in science. It is argued further that the basic principles of the theory was first enunciated by Francis Hauksbee in 1709, and that they were accepted by all succeeding writers on electricity until the discovery of the Leyden jar in 1746 led to grave difficulties. An analysis is then given of the debate within the European scientific community following the publication in 1751 of Benjamin Franklin's first papers on electricity. The more sympathetic view which has been taken of the effluvial tradition leads to a reassessment of Franklin's contribution to electrical theory.
Dissert. Abstr.

N68-35084 Arizona Univ., Tucson.
ELECTROSTATIC CORRECTION OF THE SPHERICAL ABERRATION OF ELECTRON LENSES
James Edmond Barth (Ph.D. Thesis) 1967 83 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-16513

The spherical aberration of electron lenses of which the refracting fields are axially symmetric, static, and space charge free is always positive. The spherical aberration of an electrostatic lens in which surface charges are introduced within the electron beam on a metal gauze or a conducting foil can be given an arbitrary value by adjusting the electrostatic field at the gauze or foil. The performance of gauze lenses is limited by the lens action of the gauze holes. If a gauze lens is given a zero spherical aberration and used to provide the principal lens action, the aberration figure due to the gauze holes of diameter Δ has a diameter in the image plane of about $(1+M)\Delta$ where M is the magnification of the lens. If a gauze lens is used to correct the spherical aberration of a normal magnetic lens which is used to provide the principal lens action, the aberration figure due to the gauze holes is a factor $2\Delta/h$—where h is the radius of the lens aperture—times smaller than the minimum spherical aberration figure of the uncorrected lens. Dissert. Abstr.

N68-35085 Houston Univ., Tex.
PRODUCTION AND DETECTION OF SOLITARY MACROSCOPIC QUANTIZED VORTICES IN HELIUM 2 USING ULTRASONIC CAVITATION
Mamerto Loarca Chu, Jr. (Ph.D. Thesis) 1967 99 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-16129

Knowledge of cavitation nucleation in various liquids, and of cavitation in liquid helium is reviewed. Ultrasonic cavitation was induced using a plane standing wave system resonant at 89 kc/s, and the threshold for cavitation noise measured for different rotation rates of a shaft with an attached paddle turning in the vicinity of the sound field. Below the lambda point, the threshold was found to be lowered sharply at a critical revolution rate, ω_c. The experiment was repeated with five different shaft sizes and was found to be inversely proportional to r^2, where r is the radius of the shaft. The constant of proportionality was found to be h/m, where m is the mass of one helium atom. Further smaller threshold reductions were observed at rotation rates of about $2\omega_c$. With this system no threshold reduction was observed with a shaft without an attached paddle even at very high rotation rates. Dissert. Abstr.

N68-35118# California Univ., Livermore. Lawrence Radiation Lab.
NOISE REDUCTION CONFERENCE
[1968] 274 p refs Meeting held 5–7 Mar. 1968
(Conf-680303) CFSTI: HC $3.00/MF $0.65

In the papers presented, attention is focused on the different types of noise and the characteristics of each, and on some practical methods of identifying, measuring, and reducing noise. For individual titles, see N68-35119 through N68-35139.

N68-35119# California Univ., Livermore. Lawrence Radiation Lab.
STATISTICAL FACTORS IN NUCLEAR RADIATION DETECTORS
F. S. Goulding *In its* Noise Reduction Conf. [1968] p 1–11 (See N68-35118 22-23)

Statistical problems involved in deriving the amplifying signals from radiation detectors are discussed. Topics discussed include energy absorption—electrical signal conversion processes in various detectors, electronic noise, microphonics, nuclear collisions, and trapping effects. NSA

N68-35120# California Univ., Livermore. Lawrence Radiation Lab.
SOURCES OF ELECTRICAL NOISE IN INSULATION
Howard M. Grahm *In its* Noise Reduction Conf. [1968] p 12–19 refs (See N68-35118 22-23)

Structural and dielectric insulation can be responsible for the generation of electrical noise in three general ways: (1) ionization, or corona, as a result of high electrical stress, either DC or from pulsed or alternating voltage; (2) electrical charge generation due to friction between insulation and conductors, or within the insulation itself; and (3) piezoelectric and quasi-piezoelectric charge generation due to mechanical stress, vibration, or shock impact. The causes of these various types of noise are discussed, and methods of elimination or suppression are suggested. Author

N68-35124# California Univ., Livermore. Lawrence Radiation Lab.
ELECTROMAGNETIC SHIELDING PRINCIPALS
Clifton L. Whitten *In its* Noise Reduction Conf. [1968] p 68–79 refs (See N68-35118 22-23)

The characteristics of electromagnetic fields are reviewed on the basis of their impedance characteristics (electric or high-impedance, magnetic or low-impedance, and plane waves). The shielding effectivenesses of various materials as a result of reflections due to impedance mismatches and attenuation due to absorption are discussed. The characteristics of leakage through apertures are considered and information is presented to allow calculation of these effects. Multiple apertures are included. Detrimental effects on shielding of corrosion, poor joints, non-conductive coatings, etc., are considered. Characteristics of leakage through apertures is extended to cover consideration of waveguides below cut-off and their use as attenuators for the passage of air, tuning shafts, etc. Tables and nomographs are presented covering electrical, mechanical, and chemical properties of those materials most likely to be encountered. Author

N68-35125# LectroMagnetics, Inc., Los Angeles, Calif.
SIMPLIFIED RF ELECTROMAGNETIC SHIELDING
Fred J. Nichols *In* Calif. Univ. Noise Reduction Conf. [1968] p 81–104 refs (See N68-35118 22-23)

Applications of RF electromagnetic shielded enclosures for large cabinets and shielded rooms are discussed. A general review is given of fundamental equations necessary to a basic understanding of how RF shielding is obtained. The use of these fundamentals given in graphic form in order to show clearly their effects on obtaining a suitable RF shielded enclosure. Use of various materials, assembly techniques, doors, ventilators, power line filters etc. are discribed briefly in order to demonstrate the end performance of a given RF enclosure compared to its design objective. Author

N68-35126# California Univ., Livermore. Lawrence Radiation Lab.
TRANSIENTS IN POWER SYSTEMS
Francis B. Headley *In its* Noise Reduction Conf. [1968] p 105–124 refs (See N68-35118 22-23)

Transient voltages conducted along power lines may cause breakdown of equipment or faulty operation. If these voltages occur during the period in which measurements are being attempted, the measurements may be completely obliterated or at least seriously obscured or distorted. It is the purpose of this discussion to indicate some of the sources of these transients, then further to discuss their possible effects on measuring circuits or equipment, and finally to cover some methods of minimizing them. The major sources of noise are leaky power line insulation, line switching, and flying particles or insects. The noise occurs primarily only during the positive half of each cycle, even though the corona starting point is lower for negative polarity than for positive polarity. Rainy weather abets the noise. One investigation, covering a total of 8000 hours of observation on two of its lines in two states, logged over 500 surges varying in magnitude from under 100 V to 3600

V. One of the best methods of minimizing induced voltages was found to be to thoroughly isolate each pair of measuring leads within a grounded sheath. A triaxial cable accomplishes this effectively. The ground connections of all circuits to the receiving end should be to a common grounding terminal. Further reduction is obtained by paralleling the outer sheath with heavy insulated standed cables or strap, also contained within the outer sheath. Installing the diagnostic lines transversely to the pulse source power lines is also beneficial. Author

N68-35127# California Univ., Livermore. Lawrence Radiation Lab.
EMP PROTECTION AS AN ASPECT OF NOISE REDUCTION
L. F. Wouters *In its* Noise Reduction Conf. [1968] p 125–130 (See N68-35118 22-23)

Nuclear explosions may locally generate peak EM fields as high as 10^5 V/M and 100 gauss. The pulse time structure contains rise times of the order of 10^{-8} sec and frequency components up to 100 MHz; VLF components around 10 kHz are particularly prominent. Electrical systems exposed to such fields may experience noise effects, particularly if they involve coupling configurations, such as conductor loops or antenna elements. An examination of various electrical and electronic design practices was performed to evaluate their pertinence to this particular noise case. The material was found to categorize as follows: systems aspects; circuit layout; shielding; grounding; cabling; and protective devices. This material has been organized in terms of criteria, design procedures and hardware specifications. An associated methodology for system protection considerations has also been outlined. Comparatively little work appears to have been published concerning the first two topics; correspondingly, the interrelationship between these classes is not well developed. With respect to System Aspects, the significant analysis factor has been the adoption of the concept of Zoning. A system may be analyzed in terms of geometric volumes defined by iso-contours of constant environmental attenuation, or of constant susceptibility levels. In a well designed system, the major zonal interfaces will coincide, and will physically correspond to purposeful structural and/or electrical elements (e.g., shields). This concept is of considerable assistance in developing cost optimization criteria for distribution of protection investments. With respect to circuit layout, the following basic recommendations are emphasized: (1) adoption of a reference node circuit layout procedure; (2) elimination of magnetic coupling loops; (3) use of tree wiring layouts; (4) adherence to zone definitions down to the circuit level; and (5) provision of energy-absorbing elements such as damping resistors. Author

N68-35128# San Jose State Coll., Calif. School of Engineering.
ELECTROMAGNETIC SMOG
George F. Moynahan, Jr. *In* Calif. Univ. Noise Reduction Conf. [1968] p 131–136 (See N68-35118 22-23)

The increasing intensity of man-made electromagnetic interference or smog is discussed, and steps which have proven successful in overcoming its adverse effect upon signal communication circuits are outlined. S.C.W.

N68-35129# California Univ., Livermore. Lawrence Radiation Lab.
A PRACTICAL APPROACH TO EMI PROBLEMS
C. Marvin Hartley *In its* Noise Reduction Conf. [1968] p 137–140 (See N68-35118 22-23)

A practical approach to electromagnetic interference problems which is recommended for use by EMI experts is discussed. Considered are problems induced by ambient and extraneous noise sources. It is suggested that the EMI expert not allow himself to become lost in a maze of circuitry, no matter how complex the instrumentation system. It is further suggested that since most noise problems are similar, it is sufficient to consider each system component as a black box thus a number of troubles can be cured without going beyond that point. It is shown that most electrical noise problems experienced over a period of several years have been due to faults in the troubled system which usually consist of errors in shielding, improper grounding, and defective or malfunctioning components. It is emphasized that the first step toward the solution of a noise problem should include a thorough inspection of the affected system. On the basis of this suggested approach, it is concluded that observance of this rule (i.e., system inspection) has, in most cases, done away with extensive searches which accomplish nothing but add to the mysteries associated with EMI. S.C.W.

N68-35130# California Univ., Livermore. Lawrence Radiation Lab.
MEASUREMENT OF ELECTRICAL NOISE
George E. Vogtlin *In its* Noise Reduction Conf. [1968] p 141–146 (See N68-35118 22-23)

Measurement of electrical noise requires knowledge of sources and coupling. Definitions necessary for this discussion are signal-to-noise ratio and field strength. The measurement of noise generators is complicated by the requirements of frequency, bandwidth, and direction. Military specifications for measurement techniques exist, and specific equipment is available. Standard antennas, field probes, and line conduction probes are specified. The steps in noise analysis consist of: (1) presence of noise; (2) localization; (3) source determination; (4) coupling mode; (5) signal measurement, and (6) corrective action. Any or all may be displaced in sequence. Localization is achieved by probe searchers or isolation techniques. Remote sources are localized by radio direction finding and time correlation. Signal characteristics are an essential part of source determination; as are shielding and shutdown of equipment. The coupling mode is either by line conduction or fields, or both. Signal measurement depends upon the coupling mode, and must be continued to determine effectiveness of corrective action. Author

N68-35161 Northwestern Univ., Evanston, Ill.
DIFFRACTION BY DIELECTRIC BODIES
Nan-Hung Kuo (Ph.D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-15268

Consideration is given to two separate, although similar, subjects: one is diffraction by a right-angled dielectric wedge; the other the effect of a thin dielectric panel on the sources. The first subject involves two-dimensional diffraction problem which can be classified as special or general boundary value problem. The special boundary value problem consists of a system of four time-harmonic wave equations and an associated special boundary condition which requires continuity of the wave function and its normal derivative across the surface of the wedge. The boundary condition for the general boundary value problem requires continuity of the wave function and a finite jump in the normal derivative across the surface of the wedge. The purpose of the second subject which involves three-dimensional diffraction problem is to study steady changes of the field vectors due to the effect of a dielectric panel on the sources. By Kirchoff's vector integral, it is verified that the resultant field in the presence of the dielectric panel is vector sum of the primary and secondary fields. Dissert. Abstr.

N68-35164 Columbia Univ., New York.
A THERMODYNAMIC STUDY OF POTASSIUM AMALGAMS
Charles Robert La Mantia (Ph.D. Thesis) 1966 261 p
Available from Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 67-16033

Experimental measurements were made of the total vapor pressure of potassium amalgams and the e.m.f. of potassium amalgam concentration cells, both as functions of temperature and

of amalgam composition. Using data from experimental measurements, the pure component vapor pressure and P-V-T data, and a model for the interaction of the gas species, the following thermodynamic properties were calculated as functions of composition along the saturation curves at pressures of 1/2, 1 and 2 atmospheres: (1) mercury and potassium activities in the liquid amalgams; (2) differential heat of vaporization; (3) liquid heat of mixing; (4) composition of the vapor in equilibrium with the amalgam; (5) equilibrium vapor compressibility factor. Isobaric thermodynamic consistency checks were performed at each pressure level. Each set of data was found to check to within 1%. The experimental data checked well with the literature data, which were available in the low end of the temperature range covered in this research. Dissert. Abstr.

N68-35218# Colorado Univ., Boulder.
THE THEORY OF ELECTROSTATIC PROBES IN STRONG MAGNETIC FIELDS
Juan R. L. Sanmartin (Ph. D. Thesis) Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. May 1968 188 p refs
(Contracts F33615-67-C-1850; DA-31-124-ARO(D)-139)
(AFFDL-TR-67-190; AD-672273)

A theory is developed of an electrostatic probe in a fully-ionized plasma in the presence of a strong magnetic field. The ratio of electron Larmor radius to probe transverse dimension is assumed to be small, and an asymptotic perturbation method of multiple scales is used. The leading behavior of the solution is found. The results obtained appear to apply to weaker fields also, agreeing with the solutions known in the limit of no magnetic field. The range of potentials for which results are presented is limited. The basic effects produced by the field are a depletion of the plasma near the probe and a non-monotonic potential surrounding the probe. The ion saturation current is not changed but changes appear in both the floating potential V sub f and the slope of the current-voltage diagram at V sub f. The transition region extends beyond the space potential V sub s, at which point the current is largely reduced. The diagram does not have an exponential form in this region as commonly assumed. There exists saturation in electron collection. The extent to which the plasma is disturbed is determined. A cylindrical probe has no solution because of a logarithmic singularity at infinity. Extensions of the theory are considered. Author (TAB)

N68-35262# Rhode Island Univ., Kingston. Dept. of Physics.
COMPUTER PROGRAM FOR ACOUSTIC PULSE-ECHO DATA REDUCTION
K. A. Kemp, M. G. Kim, and S. V. Letcher 15 Aug. 1968 33 p
(Contract Nonr-396(15))
(TR-2; AD-673269)

A FORTRAN computer program has been developed to compute ultrasonic velocity and absorption in liquids from variable distance pulse-echo measurements of sound path length, travel time, and amplitude. The calculations, data input, and computed output are described in this report. A program listing and sample output are presented for reference purposes. Author (TAB)

N68-35325# Massachusetts Univ., Amherst. Polymer Research Inst.
THE RELATIONSHIP BETWEEN MORPHOLOGY AND LIGHT SCATTERING PATTERNS FOR POLYTETRAFLUOROETHYLENE
Marion B. Rhodes and Richard S. Stein Jul. 1968 19 p refs
(Contract Nonr-3357(01))
(ONR-TR-108; AD-672901)

Two types of light scattering patterns have been observed for polytetrafluoroethylene films. It has been postulated that these patterns arise from differences in the orientation of the optic axis with respect to the morphological unit of the structure. Films, studied by the light scattering technique, have been examined by electron microscopy and the differences between the patterns are ascribed to differences in the orientation of the lamella with respect to the plane of the film. Author (TAB)

N68-35367# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
ON THE FOUNDATIONS OF ELECTRODYNAMICS Final Report, Part 2, Sep. 1965–Jun. 1968
Laszlo Tisza Jul. 1968 45 p refs Submitted for publication
(Contract Nonr-3963(24))
(Rept.-2; AD-672793)

This paper is the first in a series in which electrodynamics is developed from the ground up. The electromagnetic field is defined in terms of an infinitesimal active Lorentz transformation that alters the four-momentum of a charged structureless test particle. The Lorentz transformations are parameterized in terms of the Pauli algebra formalism developed by Tisza and Whitney. Comparison with the Lorentz force equation yields the result that the magnetic field manifests itself in a rotation of the particle momentum, the angular velocity of which is the cyclotron frequency; the electric field is in a similar relation to the hyperbolic angular velocity associated with the active Lorentz transformation describing the boost. The Maxwell equations are obtained from the usual requirement of relativistic invariance. Author (TAB)

N68-35368# Parke Mathematical Labs., Inc., Carlisle, Mass.
NUMERICAL EVALUATION OF THE SERIES EXPANSION METHOD FOR THE PREDICTION OF THE FAR FIELD INTENSITY FROM NEAR FIELD CROSS-POWER MEASUREMENTS
John L. Butler and Dorothy A. Moran Aug. 1968 22 p refs
(Contract N00014-67-C-0424)
(Rept.-0424-SR-2; AD-672774)

An evaluation of a series expansion method for predicting the far-field from near-field cross-power measurements of partially coherent sound fields is given. This series method is based on an expansion in spherical wave functions truncated to include only the number of terms equal to the number of near field measuring points (which need not be restricted to the usual separable surfaces). The evaluation is through a set of numerical examples where the predicted far field is compared with the exact far field from a theoretical source of partially coherent sound. It is shown that good results can be obtained for incoherent, partially coherent, and coherent sound fields. Author (TAB)

N68-35386# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE TIME DEPENDENCE OF PULSE TUBE RADIATION [O VREMENNOM KHODE IZLUCHENIYA IMPUL'SNYKH LAMP]
V. G. Baryshnikov 29 Sep. 1967 16 p refs Transl. into ENGLISH from Svetotekhnika (Moscow), no. 2, 1966 p 8–12
(FTD-MT-24-255-67; AD-672702)

The article presents a general formula for the radiation-time characteristic of a flashlamp, a method for finding parameters of an approximating function, and a determination of these parameter ranges and connection with impulse parameters. Limits of the approximating function are established. Transmission of the impulse through a single-stage photoreceiver is considered; plots of output amplitude vs. impulse time parameters are shown. TAB

N68-35390# Worchester Polytechnic Inst., Mass.
PROBLEMS RELATING TO PROPAGATION ON COUPLED MICROSTRIPS Final Report, 15 Sep. 1967–15 Jun. 1968
Norman W. Cook and Jerald A. Weiss Jul. 1968 35 p refs Prepared for Mass. Inst. of Tech., Lincoln Lab., Lexington
(Contract AF 19(628)-5167; ARPA Order 498)
(ESD-TR-68-226; AD-672826)

The report presents the results of an investigation on coupled microstrip propagation and related problems. Included is a conformal mapping approach to coupled microstrip propagation in the quasi-static limit. Numerical analysis of the treatment shows that it does not agree with known results in the limit of narrow strip width. A Greens function solution to the problem has been developed and is contained in a separate report. The method is illustrated by applying it to a related problem -- a dielectric rod situated symmetrically between two parallel conducting plates. A perturbation method is considered for the problem of non-reciprocal propagation in coupled microstrip. The method has been adopted so as to make use of numerical results from the Greens function solution of the reciprocal propagation problem. As a preliminary test of the perturbation approach, it is applied to a problem which can be solved exactly. Author (TAB)

N68-35451# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WEAKENING OF A NARROW PARALLEL BEAM OF LIGHT IN A TURBID MEDIUM [OSLABLENIE UZKOGO PARALLELNOGO PUCHKA SVETA V MUTOI SREDE]
A. P. Ivanov and I. Sherbaf 30 Sep. 1965 14 p refs Transl. into ENGLISH from Zh. Prik. Spektroskopii (Moscow), v. 5, no. 2, 1966 p 195-201
(FTD-MT-24-215-67; AD-672691)

The dependence of illumination by an incident parallel light beam on the optical depth was investigated for model scattering media in which the extinction coefficient epsilon and the photon surviving probability Lambda were varied. It was shown that in slightly turbid media at small depths the light extinction obeys the Bouguer law due to the negligible role of the scattered radiation in the total energy balance. However in the media with a larger epsilon at any thicknesses Bouguer law is not fulfilled. The illumination increases with increasing epsilon for beams of finite width. The important role of Lambda was shown for the extinction law of a parallel beam at light in a turbid medium. Author (TAB)

N68-35636# Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Chemische Analyse.
2 ϑ VALUES FOR X-RAY ANALYSIS WITH CALCIUM SULPHATE, (020), 2d = 15,185 Å AS THE ANALYZING CRYSTAL [2 ϑ-WERTE FUER DIE ROENTGENSPEKTRAL-ANALYSE MIT GIPS, (020), 2d = 15,185 Å ALS ANALYSATORKRISTALL]
C. Freiburg and W. Reichert Jun. 1968 87 p refs In GERMAN
(JUL-530-CA) CFSTI: HC $3.00/MF $0.65

Presented are 2 ϑ value tables from the X-ray spectral analysis of gypsum. Data are arranged by increasing wave lengths up to 13 Å. Transl. by G.G.

N68-35637# Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Chemische Analyse.
2 ϑ VALUES FOR X-RAY ANALYSIS WITH QUARTZ, (1011), 2d = 6,6863 Å AS THE ANALYZING CRYSTAL [2 ϑ-WERTE FUER DIE ROENTGENSPEKTRALANALYSE MIT QUARZ, (1011), 2d = 6,6863 Å ALS ANALYSATORKRISTALL]
C. Freiburg and W. Reichert Jun. 1968 77 p refs In GERMAN
(JUL-533-CA) CFSTI: HC $3.00/MF $0.65

Presented are 2 ϑ value tables from the X-ray spectral analysis on quartz crystal. Spectral line data for the various elements are arranged by increasing wave length up to 13 Å. Transl. by G.G.

N68-35684# California Univ., Berkeley. Lawrence Radiation Lab.
WAIST-TO-WAIST TRANSFER IN THIN-LENS OPTICS
Alfredo U. Luccio May 1968 17 p ref
(Contract W-7405-ENG-48)
(UCRL-18217) CFSTI: HC $3.00/MF $0.65

Graphs are presented, which enable one to calculate quickly the waist-to-waist transport of a charged particle beam through a line in the thin-lens approximation. The method can be used also in dealing with accelerating electrostatic lenses (immersion optics). Author (NSA)

N68-35695# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
THE ZEHENDER TECHNIQUE FOR SURFACE-ROUGHNESS MEASUREMENT
L. William Utley 17 May 1968 12 p refs
(Contract AT(29-1)-1106)
(RFP-1040) CFSTI: HC $3.00/MF $0.65

The Zehender theory and technique of surface roughness measurement using a replica film of the surface is described. The technique utilizes the interference method of measuring surface roughness but, unlike existing interference methods, provides a means of measuring surface irregularities up to about 20 mirons deep. As in the interference method, a three-dimensional picture of the surface is obtained. Since film impressions produce accurate replicas, the Zehender technique can be extended to examine surfaces that would be inaccessible to an interference microscope. The accuracy and precision of the Zehender technique are within 10 percent of the roughness in the range of 10 to 200 microinches, arithmetic average (AA). A commercially available Zehender system is evaluated. Author (NSA)

N68-35719# California Univ., Livermore. Lawrence Radiation Lab.
OBSERVATIONS OF PRECESSIONAL MOTION IN THE NEW ASTRON TANK IN THE HIGH VACUUM REGIME
J. W. Beal and W. A. S. Lamb 24 Jun. 1968 13 p
(Contract W-7405-eng-48)
(UCID-15348) CFSTI: HC $3.00/MF $0.65

A set of measurements was made to explore some properties of high vacuum trapping in the new Astron vacuum chamber with trapping resistors in place. In particular it was desired to examine some aspects of the precessional motion in the high vacuum regime. The pressure in Astron was typically 6×10^{-7} torr. Author (NSA)

N68-35749*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FOURIER TRANSFORM REPRESENTATION OF AN IDEAL LENS IN COHERENT OPTICAL SYSTEMS
Gerald J. Grebowsky Aug. 1968 74 p refs
(NASA-TM-X-63347; X-521-68-292) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A mathematical analysis of the approximations required to obtain the Fourier transform representation of an ideal lens is presented. An attempt is made to demonstrate the physical significance of the approximations and the variations from ideal results produced by neglected terms in the mathematical formulation. The approximations involved are considered in terms of the output signals in optical spectrum analyzer, optical imaging, and optical correlator systems. Author

N68-35773# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
REDUCTION OF PHASE LOSSES IN THE 6802 meV SYNCHROCYCLOTRON BY MEANS OF CORRECTION OF THE ACCELERATING VOLTAGE AMPLITUDE [UMEN'SHENIE FAZOVYKH POTER' V SINKHROTSIKLOTRONE NA 680 MeV PRI POMOSHCHI KORREKTSII AMPLITUDY USKORYAYUSHCHEGO NAPRYAZHENIYA]
I. B. Enchevich and T. N. Tomilina 1968 21 p refs In RUSSIAN Submitted for publication
(JINR-P9-3805)

Frequency-amplitude characteristics of the 680-MeV synchrocyclotron high-frequency system has a significant unevenness in band. Decrease of the accelerating voltage amplitude leads to the phase losses and to the reduction of intensity by 10–15% (due to these losses) as well as to the deactivation on corresponding radii and to the rise of the background radiation induced by the scattered beam. An additional pulse bias is created by the grid modulator (at the frequency of 18.5 and 15.5 MHz) on the grid of the high-frequency oscillator. This bias leads to the decrease of the unevenness of the amplitude characteristic and to the elimination of undesirable phenomena involved. Author (NSA)

N68-35861# Kernforschungszentrum, Karlsruhe (West Germany). Zyklotron-Laboratorium.
BEAM PROPERTY MEASUREMENTS AT THE KARLSRUHE ISOCHRONOUS CYCLOTRON
D. Hartwig, W. Linder, M. E. Loesel, G. Schatz, and H. Schweickert Apr. 1968 39 p refs
(KFK-754)

Results of measurements of the phase of the internal beam, the phase width of the internal beam, and the phase space volume of the external beam are presented. Descriptions of the methods and equipment used for the measurements are given. NSA

N68-35875# Edgerton, Germeshausen and Grier, Inc., Boston, Mass. Eastern Science and Technology Div.
MATERIALS RESPONSE TESTS, SERIES 1
Allan Clyde 8 Apr. 1968 131 p
(Contract AT(29-1)-1183)
(EGG-1183-449) CFSTI: HC $3.00/MF $0.65

Data taken by the Materials Response Laboratory, EG&G, Bedford, Massachusetts with the COGEN I electron beam machine during May of 1967 are presented. Subsequent to these tests, software techniques have been developed that allow one to extrapolate reasonably accurate beam characteristics from the limited information available in the voltage and current data taken from the COGEN center cylinder. The results quoted were calculated from these data together with an equivalent circuit to represent the load. The electron beam flux is given as a function of electron energy and time to $\leq$15 percent. Author (NSA)

N68-35894# Institute of Mathematical Sciences, Madras (India).
LECTURES ON RELATIVISTIC PHYSICS IN ONE SPACE AND ONE TIME DIMENSION
Daniel A. Dubin [1967] 32 p refs Supported in part by AFOSR and NSF
(MATSCIENCE-59) Available from Director, Inst. of Mathematical Sci., Madras-20, India: $1.00

Certain aspects of two-dimensional physics are studied. The fairly trivial Lorentz and Poincaré groups are covered, and then the relevant free fields are classified in terms of scalar fields. Also models are considered. NSA

N68-35931# Stanford Univ., Calif. Linear Accelerator Center.
SAMPLE PARAMETERS OF A TWO-MILE SUPERCONDUCTING ACCELERATOR
R. B. Neal Jun. 1968 15 p refs Presented at the 1968 Summer Study on Superconducting Devices and Accelerators, Upton, N. Y., 10 Jun.–19 Jul. 1968 Sponsored by AEC
(SU-SLAC-PUB-438; CONF-680621-2) CFSTI: HC $3.00/MF $0.65

The results derived in a previous paper by R. B. Neal was used to calculate a sample set of parameters for a superconducting version of the two-mile SLAC accelerator. The parameters were calculated at 1428 and 2856 MHz. NSA

N68-35894# Dublin Inst. for Advanced Studies (Ireland).
GRAVITATIONAL RADIATION
Julian McCrea 1968 11 l p refs *Its* Ser. A, No. 18
CFSTI: HC $3.00/MF $0.65

The gravitational radiation problem was investigated by a method of successive approximations. The determination of static and stationary fields due to a single body is described, and extended to the non-stationary case. Field properties which arise from a model universe representing a radiation field due to a finite extended source and the energy transfer in such a system are considered. The behavior of the metric tensor behavior as a field event goes to infinity in all directions of space-time is considered. Finally, loss of mass due to gravitational radiation is discussed. D.H.B.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-34825# Argonne National Lab., Ill. High Energy Physics Div.
SYMPOSIUM ON THE PRESENT STATUS OF SU(3) FOR PARTICLE COUPLINGS AND REACTIONS
1967 150 p refs Symp. held at Argonne, Ill., 6–7 Jul. 1967 Sponsored by the AEC
(CONF-670725) CFSTI: HC $3.00/MF $0.65

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5. EXPERIMENTAL TESTS OF SU(3) REACTION PREDICTIONS G. B. Yodh (Md. Univ.) p 74–104 refs (See N68-34830 22-24)
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N68-34826# Stanford Univ., Calif. Linear Accelerator Center.
REVIEW OF BASIC SU(3) IDEAS
Haim Harari *In* Argonne Natl. Lab. Symp. on the Present Status of SU(3) for Particle Couplings and Reactions 1967 p 4–16 Supported by the AEC (See N68-34825 22-24)

In the review of the basic SU(3) symmetry theory the general concept of an approximate internal symmetry is introduced, and the structure of the SU(3) algebra is discussed. The starting point is a quantum mechanical system characterized by a certain interaction Hamiltonian, it is supposed that there is a set of operators all of which commute with the Hamiltonian. NSA

N68-34827# Syracuse Univ., N. Y.
SU(3) IN MESON DECAYS
Marvin Goldberg *In* Argonne Natl. Lab. Symp. on the Present Status of SU(3) for Particle Couplings and Reactions 1967 p 17–38 Supported by the ONR (See N68-34825 22-24)

The experimental situation concerning SU(3) classifications and decay rate predictions relating to mesons is reviewed. The topics considered are meson classification, the mass formula, experimental data, assumptions in the testing of decay rates, the results of fits to decay rates, and decay rate predictions. NSA

N68-34828# Wisconsin Univ., Madison.
SU(3) AND THE BARYON SPECTRUM
D. D. Reeder *In* Argonne Natl. Lab. Symp. on the Present Status of SU(3) for Particle Couplings and Reactions 1967 p 39–55 refs (See N68-34825 22-24)

The hypothesis that SU(3) can be used to systematize the baryon spectrum is discussed. The classification of states with the same spin and parity to representations of the group is reviewed. The experimental test of SU(3) for the strong decays of the baryon resonances is considered. It is concluded from this review that there is little evidence for or against unbroken SU(3) symmetry in baryon decays, but results are at least encouraging. NSA

N68-34829# Stanford Univ., Calif. Linear Accelerator Center.
ELECTROMAGNETIC INTERACTIONS AND SU(3)
Haim Harari *In* Argonne Natl. Lab. Symp. on the Present Status of SU(3) for Particle Couplings and Reactions 1967 p 56–73 refs (See N68-34825 22-24)

The present experimental situation with respect to the SU(3) predictions for electromagnetic decays and photoproduction reactions including pseudoscalar and vector meson production is reviewed. The question of whether the photon is a member of an octet, electromagnetic mass differences, magnetic moments, the decays $\pi \rightarrow 2\gamma$, $\eta \rightarrow 2\gamma$, radiative decays $A \rightarrow B + \gamma$, photoproduction of pseudoscalar mesons, and photoproduction of neutral vector mesons are covered. NSA

N68-34830# Maryland Univ., College Park.
EXPERIMENTAL TESTS OF SU(3) REACTION PREDICTIONS
G. B. Yodh *In* Argonne Natl. Lab. Symp. on the Present Status of SU(3) for Particle Couplings and Reactions 1967 p 74–104 refs Prepared in cooperation with Ariz. Univ., Tucson (See N68-34825 22-24)
(Contract AT(40-1)-2504; Grant NSF GP-6827)
(ORO-2504-12)

Attempts to compare pure SU(3) predictions with experiment in a model independent manner are described. It is concluded that the predictions for meson–baryon reactions of the type $8\times8 \rightarrow 8\times8$ are satisfied up to the highest energies for which data are available, that the baryon exchange reactions show violation of SU(3) predictions at low energies when the relations involve Ξ or Ξ^* production, and that it is possible to fit the data on meson–baryon total cross sections the ratio of real to imaginary parts of forward scattering amplitudes and charge exchange processes using five SU(3) invariant amplitudes in the t-channel. NSA

N68-34831# Wisconsin Univ., Madison.
SU(3) SYMMETRY FOR REGGE RESIDUES
V. Barger *In* Argonne Natl. Lab. Symp. on the Present Status of SU(3) for Particle Couplings and Reactions 1967 p 105–142 refs (See N68-34825 22-24)

Experimental tests of the symmetry assumptions of SU(3) for three-particle vertices in the four-particle scattering amplitude are reviewed. The topics covered are the peripheral mechanism, meson exchange, universality and SU(3), symmetry breaking in Regge models, and baryon exchange. It is concluded that there is a very small number of possible SU(3) symmetry applications in dynamical exchange models of the scattering processes. The few accurate tests of SU(3) for vertices of the peripheral exchange mechanism that were thus far made are encouraging. NSA

N68-34858 Illinois Univ., Urbana.
THE EXPERIMENTAL DETERMINATION OF THERMAL AND NEUTRON DIFFUSION PARAMETERS BY THE USE OF EMPIRICAL FUNCTIONS
Cyrus Hall Adams (Ph.D. Thesis) 1967 96 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-11819

A method has been developed to measure diffusion equation parameters in a variety of situations. Data (temperature or neutron flux) at a number of locations and times is employed to construct polynomial approximations to the observed phenomenon. Derivatives appearing in the differential equations are evaluated from the approximating functions and are then used to determine the parameters in the equations. Summation orthogonal polynomials are used in constructing the empirical functions. These proved effective in avoiding problems associated with the usual least-squares fitting calculations. If readings were taken of the differences (not absolute values) of the observed quantity, it was found that the functions could be made closer approximations. Dissert. Abstr.

N68-34866 Cornell Univ., Ithaca, N. Y.
PHOTONEUTRINO AND OTHER NEUTRINO PROCESSES IN ASTROPHYSICS
Vahe Petrosian (Ph.D. Thesis) 1967 105 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-12628

We consider the neutrino energy production rate of various processes in a hot plasma. We discuss the photoneutrino process in detail including the position contribution to the energy and the dielectric effects of the plasma on photons. We have derived approximate analytic expressions for the energy production rate for certain limiting cases. The results of a Monte Carlo method of integration of the exact energy production rate are presented by graphs and a rough empirical formula. The energy production rate of the photoneutrino process has been compared with the rates of pair-neutrino, plasma-neutrino recombination neutrino, Bremsstrahlung and photon-photon scattering processes. Dissert. Abstr.

N68-34903 California Univ., Berkeley.
PRESSURE WAVE GENERATION IN FISSIONING GASES
Walter Nicholas Podney (Ph.D. Thesis) 1967 146 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-11658

The theory of the generation of pressure waves in closed tubes containing nonmultiplying or multiplying fissionable gases is presented. Two means of producing pressure waves are considered: (1) an external neutron pulse irradiating an initial segment of a tube containing a nonmultiplying fissile gas, such as boron-10-trifluoride, and (2) an internal neutron pulse arising from neutron multiplication in a fissionable gas, such as uranium-235-hexafluoride, that is compressed to a supercritical state by a shock wave propagating into the segment of a tube imbedded in a neutron reflecting material. In each case, the reacting substance is considered to behave as a perfect gas with constant specific heats. Energy transport within the fissioning gas, either by conduction or by nuclear fragments, is neglected. Transverse gradients, body forces, and viscous forces are assumed to be negligible, so that the flow fields are one-dimensional. Dissert. Abstr.

N68-34945 California Univ., Davis.
AN EXPERIMENTAL [INVESTIGATION] OF MULTIPLE PHOTON COMPTON PROCESSES
Michael Rushton Mc Gie (Ph.D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-11698

The double Compton and triple Compton processes were investigated experimentally. The cross section for the double

Compton effect was measured at two sets of detector angles and was shown to be in agreement with theory. Existence of the triple Compton effect was verified and the cross section was measured. The double Compton experiments consisted of placing beryllium targets in a collimated beam of 662 keV gamma rays from a 6 curie Cs^{137} source, detecting the emitted photons with NaI crystals fitted with photomultipliers, and recording the energy spectrum of coincident photons on a two parameter pulse height analyzer. Data were taken at two sets of detector angles. In both cases the two detectors were in a plane perpendicular to the gamma ray beam. In one case the two detectors were separated by 90° and in the other case by 120°. The intensity of the incident gamma ray beam was measured by analyzing the spectrum of Compton scattered photons. Dissert. Abstr.

N68-34968 California Univ., Los Angeles.
VARIABLE ENERGY EXTRACTION FROM A NEGATIVE ION CYCLOTRON AND RELATED MEASUREMENTS
Arthur Carl Paul (Ph.D. Thesis) 1967 204 p
Available from Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 67-14321

A scheme has been developed at UCLA for the variable energy extraction of 25 to 48 MeV protons into a common external beam transport system. The extraction is accomplished by stripping negative hydrogen ions with a thin foil. The magnetic field is held constant while the radius and azimuth of the stripping foil are chosen so that the trajectories for any energy cross at a common point outside the cyclotron vacuum tank. A small combination magnet placed at this crossover point bends the trajectories into a common beam transport system. The first order ion optic matrix representing the fringing field of the cyclotron is calculated at five different energies. An ion optic calculation of the beam transport system is given for two different phase space vectors at the stripper. Comparison is made with the observed operating values. Dissert. Abstr.

N68-34971 Cornell Univ., Ithaca, N. Y.
MODEL ATOMIC HAMILTONIANS
Kenneth Robert Piech (Ph.D. Thesis) 1967 52 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-12629

A model Hamiltonian for the n = 1 and n = 2 states of the first and second row atoms is developed. The model is easily soluble and represents total and ionization energies reasonably well. The model is constructed on a cubic lattice space and is defined by five postulates. They are: (1) Each electron is confined to seven lattice sites: the origin and its six nearest neighbor sites; (2) the form of the Hamiltonian is taken from the finite difference approximation to the exact Hamiltonian; (3) the parameters in the Hamiltonian are determined phenomenologically; (4) the parameters scale as simple functions of Z. The fifth postulate allows one to distinguish s states from p states in the spectra of the models. A matrix diagonalization problem results which is easily solved by perturbation expansion. The model is applied to the atoms H to B, together with associated isoelectronic sequences. Dissert. Abstr.

N68-34975 European Organization for Nuclear Research, Geneva (Switzerland).
TOPICAL CONFERENCE ON HIGH-ENERGY COLLISIONS OF HADRONS, VOLUME 1
29 Feb. 1968 687 p refs Conf. held at Geneva, 15–18 Jan. 1968; Sponsored by the Intern. Union of Pure and Appl. Phys.
(CERN-68-7, V. 1)

The conference papers presented pertain to developments and problems concerning high energy collisions of hadrons, of the two-body as well as the many-body type. The energy region covered goes from about 3 GeV, where collisions are apparently no longer dominated by resonances, to about 30 GeV, the highest energy at which accelerator experiments were conducted. For individual titles, see N68-34975 through N68-34999.

N68-34976 Wisconsin Univ., Madison. Dept. of Physics.
TOTAL CROSS SECTIONS AND ELASTIC SCATTERING NEAR THE FORWARD DIRECTION
V. Barger *In* CERN Topical Conf. on High-Energy Collisions of Hadrons, Vol. 1 29 Feb. 1968 p 3–59 refs (See N68-34975 22-24)

Theoretical interpretations of experimental data on four classes of elastic scattering experiments are discussed in the context of the related theoretical concepts. These include: (1) Coulomb interference experiments and dispersion relations data establish the existence of sizeable negative real parts for the p and pp scattering amplitudes in the 10 to 20 GeV region. (2) Total cross sections and symmetries are examined in terms of the sum rules from SU[3] and universality, SU[3] versus the universality dilemma, Regge pole models of forward elastic scattering, and vector meson–nucleon total cross sections. Tabulations are included on the sum rules from SU[3] and/or universal couplings, association of meson Regge trajectories with particles, Regge model for total cross sections, and fitted parameters for the CHKN Regge model. (3) Regge pole models of elastic scattering are discussed in relation to the general character of exchange amplitudes. Regge dips, Pomeranchuk trajectory, polarization data, crossover phenomenon, $\pi^- \pi$ scattering data, and asympotic projections. (4) For the diffraction models, the pp data is empirically described, along with the extended structure of the proton. M.G.J.

N68-34977 Birmingham Univ. (England). Dept. of Physics.
EXPERIMENTAL REVIEW OF THE FORWARD PEAK IN INELASTIC TWO-BODY PROCESSES
D. C. Colley *In* CERN Topical Conf. on High-Energy Collisions of Hadrons, Vol. 1 29 Feb. 1968 p 60–110 refs (See N68-34975 22-24)

The shapes and sizes of forward peaks in quasi-two-body reactions, and the ways in which these properties depend on energy are discussed. The general trends established by bubble chamber experiments are surveyed, along with the use of a simple Regge model for interpreting the charge exchange experiments. The specific reactions discussed include the KN and $\bar{K}N$, the πN, nucleon isobar production, s-channel effects, and photoproduction. It was concluded: (1) Bigger and more precise experiments are required, as a cross section of 1 μb gives only 100 events per 10^8 pictures even in a 2-meter hydrogen chamber. Such processes as production of two-body final states with a hyperon in K–p collisions probably cannot be studied above 10 Gev/c where the cross sections have already fallen to about 5 μb and are still dropping as p^{-3}. (2) Certain reactions, particularly those that do not involve wide resonant states, can be studied best using spark chambers or counters. (3) For those reactions that can only be studied completely in bubble chambers attention must be directed toward building up the numbers of events while keeping background levels low. M.G.J.

N68-34978 Argonne National Lab., Ill.
BACKWARD PEAKS (EXPERIMENTAL)
M. Derrick *In* CERN Topical Conf. on High-Energy Collisions of Hadrons, Vol. 1 29 Feb. 1968 p 111–160 refs (See N68-34975 22-24)

Experimental data on the backward peaks in two-body reactions initiated by hadrons are examined, and extensive use is made of figures to plot the findings. Pros and cons are presented on optical model interpretation, the influence of resonance on backward scattering, the possible existence of resonances in the direct channel, the suitable choice of parameters for fitting data in the intermediate energy range with resonances, high energy data, the Regge pole fits to backward $\pi^{\pm}p$ scattering, inelastic processes

involving N and Δ exchange, backward peaks in K±p scattering, and inelastic processes involving S = −1 baryon exchange. Tabulated data are included on the elasticity values from backward scattering and total cross sections; the slopes of π+p backward scattering peaks near 180°, and the value of the constant a in $d\sigma/du = Ke^{au}$; a comparison of trajectory parameters with the parameters obtained from resonance masses; and forward and backward peaks in associated production. M.G.J.

N68-34979 Commissariat a l'Energie Atomique, Saclay (France).
SPIN PHENOMENA IN TWO-BODY COLLISIONS, INCLUDING RESONANCE DECAY (EXPERIMENTAL)
L. van Rossum *In* CERN Topical Conf. on High-Energy Collisions of Hadrons, Vol. 1 29 Feb. 1968 p 161–217 refs (See N68-34975 22-24)

Specific production mechanisms contained in final state polarization are considered. Bubble chamber data on polarization effects, and their relation to models for resonance production, are discussed; it is pointed out that no model has yet given a simple interpretation of all observed effects. The examples presented cover pion exchange, vector meson exchange, exchange with arbitrary G, one particle exchange absorption calculations, Regge model calculations, quark model calculations, and symmetry model calculations. Bubble chamber results, based on observations of the polarization of boson resonances produced in two-body collisions, are assessed. Electronic experiments for studying the mechanism of high energy collisions are discussed in terms of the dependence of the analytical method used on the energy region. Examples of Regge model calculations are given to illustrate the fact that simultaneous fits to all existing data enable even models with many parameters to make specific predictions of polarization effects, and to test the symmetry and/or universality relations for the couplings. M.G.J.

N68-34980 Jagellonian Univ., Cracow (Poland). Inst. of Physics.
PHENOMENOLOGICAL THEORIES OF TWO-BODY COLLISIONS AT HIGH ENERGY, ESPECIALLY INELASTIC COLLISIONS
A. Bialas *In* CERN Topical Conf. on High-Energy Collisions of Hadrons, Vol. 1 29 Feb. 1968 p 218–251 refs (See N68-34975 22-24)

The main advantages of using the Regge pole model for describing the high energy two-body processes are cited: (1) The idea that the high energy processes in the s-channel are related to the particles or resonances exchanged in the crossed channel forms the very basis of the model. (2) All requirements of analyticity of the scattering amplitudes can be built into the model; therefore, the predictions do not violate the fundamental principles of field theory. (3) The model is very flexible and may be used to describe quite complicated and subtle effects in scattering amplitude structures. It is pointed out that the crucial problem for further developments of the Regge pole phenomenology of inelastic processes is to understand the vector meson production processes, particularly the role played by conspiracy. The promising potential of the quark model is noted, and the main problems to be clarified are identified as parametrizing the quark–quark amplitudes and attempting to fit the existing data; generalizing the model for higher resonances; and finding a consistent way of calculating or estimating the corrections to the simplest version. M.G.J.

N68-34981 Stanford Univ., Calif.
TWO-BODY PROCESSES WITH LARGE MOMENTUM TRANSFER
Martin L. Perl *In* CERN Topical Conf. on High-Energy Collisions of Hadrons, Vol. 1 29 Feb. 1968 p 252–289 refs (See N68-34975 22-24)

Concepts are reviewed on the behavior of two-body processes at momentum transfers large enough to be outside the diffraction peak region. The large differences in behavior between different two-body interactions in this region are noted, and it is pointed out that there is no longer a clear distinction of a theoretically significant separation between the small $|t|$ and the large $|t|$ parts of a two-body process. Examples and illustrations are given to illustrate these viewpoints. Incident momenta at or above 3 GeV/c are used to avoid resonance and threshold effects. The data discussed pertain to proton + proton elastic scattering, neutron + proton elastic scattering, antiproton + proton elastic scattering, kaon + proton elastic scattering, and pion + proton elastic scattering. Several inelastic two-body interactions are also considered, along with the reactions and measurements of inelastic quasi-two-body interactions. It is concluded that, even for simple elastic scattering, more measurements are needed for almost all systems at 4.0 GeV/c and above. M.G.J.

N68-34982 European Organization for Nuclear Research, Geneva (Switzerland).
RIGOROUS THEORETICAL CONSIDERATIONS ON HIGH ENERGY SCATTERING
H. Epstein *In its* Topical Conf. on High-Energy Collisions of Hadrons, Vol. 1 29 Feb. 1968 p 290–315 refs (See N68-34975 22-24)

Some consequences of the so-called axiomatic field theory are reviewed, starting with a local field theory in the sense of Wightman. Attention is centered on the linear program which consists in finding the envelope of holomorphy H(D) of D, with consideration given to the Steinman identities (linear relations between certain generalized retarded functions). Results obtained in the linear program for the four-point function are summarized. The work of Martin on the use of positivity and unitarity is discussed in relation to elastic processes with spinless particles; the further use of unitarity for the π–π case is also discussed. It is pointed out that based on the results of Martin, the bounds established by Froissart as a consequence of Mandelstam's representation (with polynomial boundedness) now follow from axiomatic field theory. Topics related to the Cerulus–Martin lower bound are considered. An overview is included on inelastic two-body processes; non-zero spins; and inelastic processes pertaining to analyticity properties from the linear program, and the use of Martin's results and unitarity. M.G.J.

N68-34983 Brookhaven National Lab., Upton, N. Y.
PARTICLE PRODUCTION IN HIGH ENERGY PROTON-PROTON COLLISIONS
Frank Turkot *In* CERN Topical Conf. on High-Energy Collisions of Hadrons, Vol. 1 29 Feb. 1968 p 316–344 refs Supported by AEC (See N68-34975 22-24)

The established experimental features of particle production in p–p collisions in the 5 to 30 GeV region are enumerated; these features deal mainly with average values of simple observables like center of mass (c.m.) energies and momenta averaged over all production channels. Basic conceptual and experimental problems are defined and examined in relation to bubble chamber data. Summary information is given on experiments related to cross sections versus energy; resonance production in collisions; multiperipheral model analyses; and the search for two intermediate bodies using the principal axis method, and the minimum t method. In surveying counter-spark chamber experiments, it is pointed out that most of the data on pp collisions deal with single particle spectra, i.e., a single particle is detected uncorrelated with whatever else is produced. An overview is presented on studies of the proton spectra and Bremsstrahlung models, the $\pi^{\pm}$ K^{*} and p spectra, and thermodynamic model fits to single particle spectra. The point is made that only gross features are known concerning p–p particle production in the 5 to 30 GeV region. M.G.J.

N68-34984 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
EXPERIMENTAL ASPECTS OF MANY-BODY COLLISIONS
O. Czyzewski *In* CERN Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 345–379 refs (See N68-35975 22-24)

Data are presented on bubble chamber experiments on multiple meson production which permit the identification of individual channels of a reaction. The experimental difficulties of work with high multiplicity events are listed, and cross sections are compiled for different 6-prong reactions for π^-p interactions between 5.5 and 16 GeV/c incident momentum; the percentage of useful fitted events drops from about 80% at 5.5 GeV/c to about 20% at 16 GeV/c. Also mentioned is the use of the quark model to relate partial cross sections in πp and pp interactions. In considering the general features of many-body interactions, the laboratory spectra of protons from different channels are depicted. Multi-Regge model applications and the problems involved in nucleon t-distributions are reviewed. The difference between neutron and proton behavior in the large-momentum transfer region is pointed out, and the question of whether a leading meson exists in meson–nucleon interactions is raised. An overview is presented on the findings related to high-multiplicity proton–proton interactions and to cosmic ray energies. M.G.J.

N68-34985 European Organization for Nuclear Research, Geneva (Switzerland).
THEORETICAL MODELS OF PRODUCTION PROCESSES AT HIGH ENERGY
Hong-Mo Chan *In its* Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 380–412 refs (See N68-35975 22-24)

Developments which have a direct bearing on present experiments or on experiments in the near future at machine energies are reviewed. The attractive features and the limitations, as regards direct comparison with experiment, are assessed for the Bremsstrahlung model, the thermodynamic model, the quark model, and the multi-Regge model. Indications are that the multi-Regge model has undergone the most extensive comparison with experiment. The choice of Regge variables is discussed. The problems involved in applying the Regge model to three-body reactions and to multiple production are considered in relation to the various approaches used. It is pointed out that each of the models has achieved some success in explaining parts of the data; in certain cases, the models overlap and seem to be describing the same thing in different languages. The need for further study of each is stressed. M.G.J.

N68-34986 European Organization for Nuclear Research, Geneva (Switzerland).
ON ELECTROMAGNETIC CORRECTIONS TO THE DISPERSION RELATIONS FOR HIGH ENERGY FORWARD SCATTERING
L. D. Soloviev *In its* Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 431–440 refs (See N68-34975 22-24)

Two methods are discussed for analyzing the role of ordinary electromagnetic interaction of hadrons in the dispersion relations for their scattering: (1) The electromagnetic corrections to nuclear amplitude are calculated, and dispersion relations for nuclear interactions are tested. This approach requires more information about electromagnetic interaction of hadrons than simple knowledge of its casual nature, and relies on approximate models. (2) An analysis is made of the general properties of the scattering amplitude which is derived directly from experiment and contains the contributions of both strong and electromagnetic interactions. Dispersion relations for this amplitude are derived. Author

N68-34987 Tokyo Univ. (Japan). Dept. of Physics.
GENERALIZED SUPERCONVERGENCE RELATIONS AS A GUIDE TO HIGH ENERGY SCATTERING OF HEDRONS
Keiji Igi and Satoshi Matsuda *In* CERN Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 441–459 refs (See N68-34975 22-24)

Low energy integrals in the narrow-width approximation are calculated, using generalized superconvergence relations (GSCR). This is based on an application of GSCR for the case of the π^-p helicity-nonflip forward scattering amplitude with charge exchange, $f^{(-)}(\bar{t})$. A particular advantage of this type of GSCR at $t=0$ is cited as the ability to check the sum rule exactly by experiments, and its use to probe the J-plane singularities by measuring the total cross sections precisely. It is pointed out that the GSCR can be written down for a particular amplitude (Helicity-flip or -nonflip) controlled by only one Regge pole, that the GSCR is particularly useful for pinning down the zeroes which are characteristic in the Regge formula and for tracing out the trajectory. Consideration is also given to ghost-eliminating zeroes in the Regge pole model. It is concluded that GSCR is a very important guide to high energy scattering of hadrons. M.G.J.

N68-34988 Paris Univ. (France). Inst. of Nuclear Physics.
πN RESONANCES AND BACKWARD SCATTERING
H. Hoegaasen *In* CERN Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 460–470 refs (See N68-35975 22-24)

Some aspects of πN resonances and backward scattering are discussed in the framework of the Regge pole model. The resonance formation channel is called the u-channel (u denotes the square of the total center of mass energy); the channel for studying high energy backward scattering is called the s-channel (with s denoting the center of mass energy squared). The crossing symmetry makes πN resonances and backward scattering intimately related: an intermediate resonance state in the u channel $\bar{\pi}N \rightarrow \bar{\pi}N$ is just what is expected to be exchanged in backward s-channel $\pi N \rightarrow \pi N$ scattering. Author

N68-34989 State Univ. of New York, Stony Brook.
AXIOMATIC PROOF OF SUPERCONVERGENCE RALATIONS
Gilbert Mahoux and Andre Martin *In CERN* Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 471–477 refs (See N68-24975 22-24) Supported in Part by AFOSR, Washington, D. C.

As the first step of proof in the scalar case, it is shown that the classical results of axiomatic field theory, namely the validity of dispersion relations for $t=0$ (forward) and $-t_0 \leq t \leq 0$ (t physical), the existence of the Lehmann ellipse, and the results of other data, when combined with unitarity imply a bigger analyticity domain, such that dispersion relations can be extended to complex t, $|t| < R$, where R, in most cases is 4 pion masses squared. In the scalar case, unitarity enters in a very simple way; formulas are derived for the absorptive part of an elastic scattering amplitude $A+B \rightarrow A+B$. To extend such proof to the case of particles with spins, an invariant amplitude is constructed, free from kinematical singularities, which has absorptive parts across the s and u cuts to satisfy the conditions in the formulas and the analog in the u channel. Author

N68-34990 European Organization for Nuclear Research, Geneva (Switzerland).
PROBLEMS CONNECTED WITH HIGH ENERGY SCATTERING NEAR THE FORWARD DIRECTION
Ph. Salin *In its* Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 478–493 refs (See N68-34975 22-24)

Several examples are presented on the failure of the simple Regge pole model. The implications of the constraint equations, and

of evasion or conspiracy are considered for the nucleon–nucleon scattering case. Although this process is described in terms of five helicity amplitudes, attention is focused on only two amplitudes in the s-channel to which the pion contributes. The results obtained are generalized to the general problem of arbitrary spins and masses. Also analyzed are phenomenological fits with pion conspiracy. The conclusion is drawn that it is very difficult to describe all processes with the pure Regge pole model in which only moving poles are the dominant contributions, and that modifications of the pure model, such as fixed poles, cuts, absorption, etc., may be necessary. M.G.J.

N68-34991 Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
REGGE FAMILIES IN BROKEN SL/2, C/
G. Domokos and P. Suranyi *In* CERN Topical Conf. on High-Energy Collisions of Hedron, Vol. 1 29 Feb. 1968 p 494–522 refs (See N68-34975 22-24)

An elementary exposition is presented on some algebraic methods in Regge theory leading to the classification of Regge poles according to a trajectory generating algebra SL/2,C/ at zero momentum transfer. The classification is extended to nonvanishing momentum transfers leading to a universal classification of Regge trajectories. The theory is applied to the phenomenological classification of the nucleon and delta trajectories. Author

N68-34992 Michigan Univ., Ann Arbor.
RECENT EXPERIMENTAL RESULTS ON n-p SCATTERING FROM 6 TO 30 GeV/c
Michael J. Longo *In* CERN Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 523–536 refs (See N68-34975 22-24)

An assessment is made of the data obtained from the experiments which were conducted with neutron beams using counter and spark chamber techniques. Measurements of the n–p total cross sections in the 14 to 27 GeV/c region appear to confirm that σ_T(np) becomes less than σ_T(pp) around 14 GeV/c and that the two cross again near 28 GeV/c. Neutron total cross sections are tabulated, along with the experimentally observed screening correction. Total cross sections for neutrons on nuclei at 27 GeV/c were also measured in the same experiment, and the data are compared with results of other studies on 20 GeV/c protons. Preliminary results are presented on cross section measurements for n–p diffraction scattering from 8 to 30 GeV/c, and results at three different mean neutron energies are compared: 5.9, 10.5, and 22.5 GeV. Evidence is seen for shrinkage of the diffraction peak between 6 and 10.5 GeV, but none is apparent between 10.5 and 22.5 GeV with the present statistical accuracy. M.G.J.

N68-34993 Paris Univ., Orsay (France). Lab. de l'Accelerateur Lineaire
COHERENT PRODUCTION OF MULTIPION FINAL STATES IN π-INTERACTIONS WITH NUCLEI
J. J. Veillet *In* CERN Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 537–555 refs (See N68-34975 22-24)

Inelastic interactions and the results obtained in a heavy liquid bubble chamber are discussed. The general characteristics of particle production on nuclei are defined in terms of coherent production, differential cross section in coherent production, and incoherent production. In experiments conducted at 15 and 16 GeV/c π^- in pure light freon, many different multipion final states were studied for coherent production. The number of pions in the final state was 2, 3, 4, or 5 and their total charge 0 or −1. An effect was observed which was attributed to coherent inelastic reaction in the 3π and 5π charge −1 channels. As the coherent effect is observed only for the negatively charged states with an odd number of pions, the existence of the following selection rules is suggested: G-parity conservation, and conservation of charge between incident and outgoing particle. These selection rules are discussed theoretically, and the effect of absorption on cross sections is considered. It is concluded that coherent production occurs for elastic-like reactions, i.e., reactions where isospin, G-parity, and the spin parity series are conserved. M.G.J.

N68-34994 Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
NEW EXPERIMENTAL RESULTS ON THE PHOTOPRODUCTION OF MESONS
E. Lohrmann *In* CERN Topical Conf. on High-Energy Collisions of Hedrons, vol. 2 29 Feb. 1968 p 556–570 refs (See N68-34975 22-24)

Experimental data are presented on photoproduction at energies above a few GeV. For the photoproduction of pseudoscalar mesons, figures depict the differential cross sections for the reaction $\gamma p \rightarrow n\pi^+$ for small values of $|t|$, together with predictions from a Regge pole model without conspiracy and a model using the electric Born terms; for the reaction $\gamma p \rightarrow n\pi^0$, together with predictions from a Regge pole model; differential cross section for the reaction $\gamma p \rightarrow \Lambda K^+$; and values of cos ϕ obtained from the triangle in equality implied by SU_3 for the cross sections $\gamma p \rightarrow \Lambda K^+$, $\gamma p \rightarrow \Sigma^0 K^+$, $\gamma p \rightarrow n\pi^+$. For the photoproduction of rho mesons, the cross section is depicted for the reaction $\gamma \rightarrow p\rho^0$ as a function of photon energy, and the dependence of the differential forward cross section of rho production on the atomic number A of the target nucleus is graphed. Seven applications of the vector dominance model are also discussed. M.G.J.

N68-34995 Brookhaven National Lab., Upton, N. Y.
HIGH ENERGY NEGATIVE PION-PROTON, NEGATIVE KAON-PROTON, AND ANTIPROTON-PROTON ELASTIC SCATTERING
R. Rubinstein, A. Ashmore, C. J. S. Damerell, J. Orear (Cornell Univ., Ithaca, N. Y.), D. P. Owen (Cornell Univ., Ithaca, N. Y.) et al *In* CERN Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 571–579 refs Sponsored by the AEC Prepared in cooperation with Cornell Univ., Ithaca, N. Y. (See N68-34975 22-24)

Experimental results are presented on the study of high energy elastic scattering of π, K and $\bar{p}$ from protons. Elastic scattering of $\pi^\pm$ from protons between 5.9 and 14 GeV/c was measured for center-of-mass angles 135° to 165°; measurements of elastic scattering of π^-, K− and $\bar{p}$ from protons at 5.9 GeV/c for center-of-mass angles 20° to 110° were made and also for a more limited angular range at 7.9 and 9.8 GeV/c. Author

N68-34996 European Organization for Nuclear Research, Geneva (Switzerland).
STRUCTURE IN THE ANGULAR DISTRIBUTION OF PROTON–PROTON ELASTIC SCATTERING AT LARGE MOMENTUM TRANSFERS
J. A. Allaby, A. N. Diddens, A. Klovning, E. Lillethun, E. J. Sacharidis et al *In its* Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 580–594 refs (See N68-34975 22-24)

Elastic proton–proton angular distributions, covering in about 15 steps the angular range from 40° to 90° c.m., were measured at incoming momenta of 7.1, 8.1, 9.2, 10.1, 11.1, and 12.1 GeV/c. The point to point error (mainly statistical) was usually 3% to 4%. Tabulated data are presented on the d.m. differential cross section, $d_\sigma/d_{\Omega'}$ in units of 10^{-30} cm^2/sr, as a function of the incoming lab momentum P_{lab} in units of GeV/c, and the c.m. scattering angle in units of degrees. A graphical comparison is drawn between the results obtained and other experimental data, giving information on the angular distributions at fixed energy in

the angular region outside the diffraction peak. For completeness, some diffraction curves or points with larger errors of older experiments are shown also. M.G.J.

N68-34997 Liverpool Univ. (England). Nuclear Physics Research Lab.
PION PION SCATTERING EFFECTS IN PROTON ANTIPROTON ANNIHILATIONS AT 2.5 GeV/c
J. Clayton, P. Mason, H. Muirhead, and P. Renton *In* CERN Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 595-598 refs Supported by the Sci. Res. Council, London (See N68-34975 22-24)

Note is made of the poor fit obtained to $\pi\ \pi$ effective mass distributions in the region of low $\pi\ \pi$ masses (i.e. between 380 and 500 MeV) in multipion systems, when fitted with the conventional normalized phase space. Also observed is the discrepancy between phase space and the histograms which seems to follow a significant pattern. To illustrate the nature of these effects, the ratio (R) of the number of $\pi\ \pi$ entries in the histogram to the number predicted from phase space is plotted against the $\pi\ \pi$ effective mass for MeV. The errors in the points lie between 5% and 10%. The rise of R above 1 in the region of mass 750 MeV is seen as an indication of ρ meson production. It is felt that a possible way to parametrize this effect would be to regard it as a $\pi\ \pi$ scattering effect. M.G.J.

N68-34998 Bonn Univ. (West Germany). Physics Inst.
INFLUENCE OF RESONANCE PRODUCTION OF THE PION-PAIR ANGLE-DISTRIBUTIONS IN THE REACTION PION PROTON YIELDS PROTON 5 PION
K. Boeckmann and H. Drevermann *In* CERN Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 599-610 refs Prepared in cooperation with Kernforschungsanlage, Juelich, West Ger. (See N68-34975 22-24)

Experimental results obtained from the pion-pair angle distributions of the reaction $\pi\ p \rightarrow p5\ \pi$ are summarized. The influence of ρ^0 production on the pion-pair angle distributions is discussed, assuming a simple statistical model neglecting interference effects. It is shown that the presence of the ρ^0 mesons leads to an energy dependence of the difference $A_u - A_l$. Effects are also investigated by which the presence of the N^* may affect the pion-pair angle, and possible reasons for the observed difference between A_{++} and A_{--} are considered. It is indicated that a careful examination of the influence of resonance production and kinematic effects is necessary when studying $\pi\pi$ correlations in πp interactions. It was observed that in the reaction $\pi^+ p \rightarrow p\ 3\pi^+ 2\pi^-$ at 5 GeV/c the difference between the angular distributions of pairs of positive pions and that of negative pions is strongly correlated to the backward peaking of the proton. M.G.J.

N68-34999 Istituto Nazionale di Physica Nucleare, Milan (Italy).
REACTIONS PRODUCING THREE FINAL PARTICLES AND COMPARISON OF THE DOUBLE REGGE POLE MODEL WITH SOME EXPERIMENTAL DATA
S. Ratti *In* CERN Topical Conf. on High-Energy Collisions of Hedrons, Vol. 1 29 Feb. 1968 p 611-647 refs (See N68-34975 22-24)

Double Regge pole model predictions are compared to experimental data based on an extensive π^--proton experiment at 11 GeV/c. The models of interest were proposed for reactions of the type: $1 + 2 \rightarrow + 4 + 5$ where particles 3, 4, and 5 are assumed to be completely uncorrelated. Their validity is essentially limited to the central region of the Dalitz plot, when all the two-body effective masses squared $M^2(34)$, $M^2(45)$, and $M^2(35)$ are generally large. Various mathematical formulations are described. The number of events are selected on the basis of c.m.s. momentum, provided the mass of a pair of particles is in a resonance band. Linear Regge trajectories are assumed, and two diffractive parameters are determined. The analysis indicates that the multi-Regge pole model might be acceptable for describing many-body processes. M.G.J.

N68-35012 Rice Univ., Houston, Tex.
SPIN DEPENDENT ATOMIC REACTIONS IN A HELIUM DISCHARGE AND EXTRACTION OF A HELIUM 3 ION BEAM FROM AN OPTICALLY POLARIZED HELIUM 3 SOURCE GAS
Norman David Stockwell (Ph.D. Thesis) 1967 105 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-13127

The collisional mixing of the excited 2^3P levels of He is investigated by experiments using the optical pumping of ^4He. The isotope shift in a ^3He lamp allows an experimental test of the theory of ^4He optical pumping developed here. The theory predicts a reversal in the sign of the optical signal as mixing conditions vary. A $^3He^+$ ion beam of $\sim$0.6 μA has been extracted from a source gas of ^3He with polarization, $P_0 \cong 3\%$. Theory indicates the beam polarization should be between P_0 and $P_0/2$. The source is designed to give a 300 keV beam which will be used to test beam polarization through the $^2D(^3He, {}^1P)^4He$ reaction. The polarization of the protons scattered at 90° is related to the beam polarization and will be measured. Using well understood techniques P_0 should be increased significantly from 3%. Dissert. Abstr.

N68-35023 Yale Univ., New Haven, Conn.
MEASUREMENT OF EXCITED STATE LIFETIMES
Peter Juergen Kindlmann (Ph.D. Thesis) 1966 197 p
Available from Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 67-98

Measurements were made of the radiative lifetimes and total destructive collision cross sections in helium, neon, and singly ionized argon. The data are sufficiently accurate to permit meaningful checks on the accuracy of various theoretical calculations. A phase-locked vernier chronotron was designed for accurate determination of lifetimes by photon-counting technique. A scheme for excited state formation by impact with threshold energy electrons was developed to eliminate errors due to cascade effects. Previous measurements of the destructive collision cross sections have been virtually nonexistent. The six major sections of the paper deal with the pertinence of these measurements to laser systems and the theoretical background; previous methods of measurement; a review of delayed multichannel coincidence techniques; the present experimental method; data analysis; and the discussion of these results. Dissert. Abstr.

N68-35024 Brown Univ., Providence, R. I.
STUDY OF SOME PERIPHERAL PROCESSES IN PION NUCLEON SCATTERING
Ramon Pinon, Jr. (Ph.D. Thesis) 1966 155 p
Available from Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 67-2278

Some peripheral processes in π-N scattering are studied. First, the reaction $\pi + N \rightarrow \pi + \pi + N$ at incident pion momentum 1.25 BeV/c and 1.59 BeV/c is investigated for small momentum transfer and for dipion mass around the ρ resonance region. Predictions based on the pion as a Regge Pole are compared with those of the pion as an elementary particle. It is found that both cases give similar results. Second, the mass and angular $\pi^- + p \rightarrow \pi^- + \pi^+ + N$, are examined. It is pointed out that the sharp peak observed over the broad ρ^0 peak in the $\pi^- \pi^+$ mass distribution can be explained as due to the electromagnetic decay of ω into $\pi^- \pi^+$, where the ω is produced via ρ exchange. The observed asymmetric $\pi^- \pi^+$ angular distribution is explained in terms of a strong s-wave $I = 0$ π-π interaction. Dissert. Abstr.

N68-35031 Houston Univ., Tex.
SPIN EXCHANGE CROSS SECTIONS OF ALKALI ATOMS
Chen-Kun Chang (Ph.D. Thesis) 1967 142 p refs
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-16140

To calculate numerically spin-exchange cross sections, the spin-dependent interaction characterizing the scattering is required. This interaction for two alkaline atoms is calculated by individually considering the interactions due to the valence S electrons and to the closed electronic shells of the two atoms. The two S electron interaction is generated phenomenologically from the known hydrogen-hydrogen interatomic potential and the closed shell interaction from interatomic potentials of two inert atoms. Theoretical potentials so obtained are in agreement with those constructed from band spectra. Unfortunately, direct observations yield spin-dependent interaction potentials only for the singlet state of the alkaline atoms. This technique is extended to obtain the interaction potentials for cases for which there is at the present time inadequate experimental information for their construction, and for those cases in which no stable molecule is formed. These interaction potentials are also used to calculate the second virial coefficients. The present theories of spin-dependent scattering of alkali-like atoms are introduced, and our potentials are used to calculate various cross sections by semi-classical techniques and by partial wave analysis. The results of the semi-classical method compare fairly well with experimental ones. Six different scattering cross sections are calculated by partial wave analysis for each of the six alkaline atoms, H, Li, Na, K, Rb and Cs, for 124 different relative kinetic energies. These cross sections are finally averaged with Maxwellian distribution for temperature from 10°K to 9500°K, and the partial results are shown in the following table. Dissert. Abstr.

N68-35032 Ohio Univ., Athens.
ANGULAR CORRELATION OF INELASTICALLY SCATTERED NEUTRONS AND THE ASSOCIATED GAMMA RAYS FROM CARBON 12 AT E_n = 14.65 MeV
Michael W. Gilpatrick (Ph.D. Thesis) 1967 126 p refs
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-14778

The angular correlation between neutrons inelastically scattered from the first excited state of Carbon 12 (Q = −4.43 MeV) and the associated de-excitation gamma rays has been measured. The neutrons were produced by the t(d,n)He^4 reaction by accelerating deuterons to 150 keV in a direct current accelerator. To allow discrimination between elastic and inelastically scattered neutrons, the associated particle time-of-flight technique was used. The gamma ray detector was placed at 90° to the incident neutron beam both in the reaction plane and perpendicular to it. The neutron system efficiency was determined by observing neutrons elastically scattered from free protons contained within a polyethylene (CH_2) sample. Similarly, the gamma ray system efficiency was calculated from the observed intensity of gamma ray production from the reaction $C^{12}(n,n'\gamma) - C^{12}$. The analysis of the correlation data embodied corrections for both random and correlated accidental coincidences. The data have been analyzed in terms of the distorted wave Born approximation. The results show that the predicted correlations are sensitive to the choice of target nucleus wave functions. In particular, configuration-mixed shell model wave functions for the first 2+ state in C^{12} do not adequately fit the experimental correlations, whereas greatly improved agreement seems to be possible if a deformed nucleus model is used for C^{12}. The optical potential used to calculate the distorted waves was similar to that used by Banerjee and Levinson (4). The measured double differential cross sections for both the in-plane and out-of-plane measurements are presented. Dissert. Abstr.

N68-35034 Tennessee Univ., Knoxville.
NON-ADIABATICITY CORRECTIONS TO THE BORN–OPPENHEIMER APPROXIMATION WITH CALCULATIONS FOR MESIC AND ELECTRONIC HYDROGEN MOLECULAR IONS
Malcolm Robert Patterson (Ph.D. Thesis) 1967 226 p
Available from Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 67-15783

For generalized hydrogen molecular ions the adiabatic approximation is excellent if $\epsilon/4$, the ratio of the mass m_3 of the binding particle to the total mass, is small (e.g., H_2^+). For $(p\mu p)^+$, $\epsilon \cong 0.213$, the large mass ratio introduces correction terms to the adiabatic approximation. A detailed formalism using rotation matrices and exact two-center "electronic" functions was worked out. The non-adiabatic corrections take the form of couplings between different electronic states. Coupled radial equations involving as many as six electronic states have been solved for ground and excited states of $(p\mu p)^+$, $(d\mu d)^+$, $(t\mu t)^+$, and $(pep)^+$. The resultant wave functions were used to calculate the probability 2γ that the lepton and either nucleus coincide. For ortho $(p\mu p)^+$ a new upper limit is $2\gamma_0 = 1.12$, as compared to the adiabatic value $2\gamma_0 = 1.165$. Variational calculations supply the lower limit $2\gamma_0 = 1.00$. Using the value $2\gamma_0 = 1.12$, the weak interaction coupling constants for muon capture in hydrogen are consistent with those for muon capture in He^3 and Ca^{40} at the axial vector coupling constant values $g_A^{(\mu)}/g_v^{(\mu)} = 1.26$ and the induced pseudoscalar coupling constant values $g_p^{(\mu)}/g_A^{(\mu)} = 16.2 \pm 3.2$. Dissert. Abstr.

N68-35056 Case Inst. of Tech., Cleveland, Ohio.
THE EXCITATION SPECTRUM FOR A BOSON GAS WITH REPULSIVE AND ATTRACTIVE INTERACTIONS
Gerald Vic Brown (Ph.D. Thesis) 1967 95 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-16061

An excitation spectrum with phonon and roton regions was found for a high density boson gas with a strong repulsive core and a helium-strength attractive well. The microscopic treatment begins with a truncated Hamiltonian containing a modified Brueckner reaction matrix in place of the interaction potential. With an assumed generalized Bose–Einstein consensation a thermodynamically-equivalent Hamiltonian is found which, when diagonalized, gives the elementary excitation spectrum. The nonlinear coupled integral equations which arise have been solved numerically on a computer for the Yntema and Schneider (Y & S) helium interatomic potential and for several modifications of it, all possessing the strong repulsive core and an attractive well. For the Y & S potential the speed of sound and the roton energy gap are nearly an order of magnitude too high. The spectrum is much closer to the experimental one for potentials with attractive wells of 60 to 80 percent of the Y & S potential. Dissert. Abstr.

N68-35083 Indiana Univ., Bloomington.
A CONFIGURATION INTERACTION STUDY OF THE $^1\Sigma^+$ STATES OF THE LiH MOLECULE
Richard Edwin Brown (Ph.D. Thesis) 1967 107 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-15069

A configuration interaction study was completed on the $1\Sigma^+$ states of the LiH molecule using a nonorthogonal one electron basis set in elliptical coordinates. A few highly optimised wave functions were obtained for the ground and first excited states. From these small basis sets a larger more complete basis set was chosen to construct a bigger wave function which gave improved results for both states. The third and fourth roots were also reported since the wave functions are extensive enough to give good upper bounds on the energies of the second and third excited states. Most of the calculated properties compare favorably with known experimental results and some light was shed on the nature of the electronic structure of these states. Calculations were carried out at 34 points on each potential curve in the range, $1 \leq R \leq 10$. All properties are reported in atomic units except the dipole moments which are reported in debeyes. Dissert. Abstr.

N68-35146# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

PROPOSAL FOR AN E+E− ELASTIC SCATTERING EXPERIMENT WITH CHARGE RECOGNITION TO BE PERFORMED AT ADONE [PROPOSTA PER UNA ESPERIENZA DI SCATTERING ELASTICO CON RICONOSCIMENTO DELLE CARICHE DA ESEGUIRSI DA ADONE]

U. Amaldi, Jr., R. Biancastelli, G. Matthiae, S. Tazzari (Comitato Nazl. Energia Nucl., Frascati), W. Ash (Princeton Univ.) et al 1 Jul. 1968 24 p refs

(ISS-68/20) CFSTI: HC $3.00/MF $0.65

An experiment devoted to the study of elastic electron-positron scattering is proposed; the apparatus contains a magnetic field by which the charges of the final particles will be recognized and eventually the annihilation amplitude determined. Author

N68-35150 Purdue Univ., Lafayette, Ind.

S-WAVE PION PION SCATTERING IN PION PROTON INTERACTIONS AT 2.7 AND 4.2 GeV/c

Philip Bruce Johnson (Ph.D. Thesis) 1967 123 p

Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-16661

Exposures of approximately 20,000 pictures at 2.7 GeV/c and 60,000 pictures at 4.2 GeV/c have been examined for two-pronged final states which satisfy the hypotheses $\pi^- p \rightarrow \pi^+ \pi^- n$ and $\pi^- p \rightarrow \pi^0 \pi^- p$. The events which fall into the effective mass region dominated by ρ production are compared by means of production and decay angular distributions to a one-pion-exchange model which includes absorption effects and effects due to interference between the ρ and an $I = 0$, $J = 0$ amplitude. The data and model are found to be in good agreement. The model is utilized to calculate $\pi\pi$ S-wave elastic scattering phases shifts from .6 to .84 GeV/c^2 in the dipion effective mass spectrum. The results indicate that the $I = 2$ amplitude is small and negative below .75 GeV/c^2 and that the $I = 0$ amplitude is a slowly increasing function of the dipion effective mass. Dissert. Abstr.

N68-35158# Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Laboratori Nazionali di Frascati.

VIRTUAL PROTON COMPTON EFFECT AND THE ELECTRON (MUON). PROTON BREMSSTRAHLUNG AS A TEST OF QUANTUM ELECTRODYNAMICS

M. Greco, A. Tenore, and A. Verganelakis 27 Jun. 1968 33 p refs *Its* Note No. 405

(LNF-68/38) CFSTI: HC $3.00/MF $0.65

The virtual proton Compton effect is studied in the approximation of a single virtual proton and a 3–3 resonance. The computation of the latter intermediate state is carried out in the framework of isobaric formalism. The contribution to the measurements of the wide angle bremsstrahlung, arising from the virtual proton Compton terms, is given explicitly. It is shown that these contributions depend strongly on the kinematical configuration of the experiments and may change appreciably the results of pure QED in the critical region where the intermediate electron or muon is far off its mass shell. The numerical results suggest that the exponential form factor is a more reasonable one, to describe the behavior of the γNN^* vertex form factor. In addition it is pointed out that proton polarization measurements in the wide-angle bremsstrahlung and large angle pair production experiments provide an important source of information about the contribution of the virtual proton Compton effect to these processes. Polarized cross sections are explicitly calculated. Author

N68-35159# Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Laboratori Nazionali di Frascati.

WIDE ANGLE ELECTRON PROTON BREMSSTRAHLUNG

C. Bernardini, F. Felicetti, L. Meneghetti-Vitale, G. Penso, R. Querzoli et al 18 Jul. 1968 10 p refs *Its* Note No. 412

(LNF-68/48) CFSTI: HC $3.00/MF $0.65

Results are presented on a measurement of wide angle electron proton cross section. The agreement with the quantum electro-dynamics prediction is good at the probed masses of 70 and 100 MeV of the virtual electron. Author

N68-35166 Purdue Univ., Lafayette, Ind.

NONEQUILIBRIUM RADIATION AND IONIZATION IN SHOCK WAVES

Claire Edwin Chapin (Ph.D. Thesis) 1967 141 p

Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-16624

Radiation energy transfer and ionization rates in the mixture of atoms, ions and electrons produced by a normal shock wave propagating in cold argon gas are examined. It is shown the gas may be regarded as a combination of two gases, one composed only of electrons and one composed of both atoms and ions. Temperature differences between the electron gas and the atom-ion gas significantly affect radiation and ionization rates in the shock wave. The analysis uses the ionization rates due to both atom-atom collisions and electron-atom collisions. In addition, photoionization, which is responsible for precursor ionization, is included. Radiation energy transfer has little effect on the ionization rate until equilibrium ionization is approached. The collisional rates then decrease and the radiative rates become relatively more important. The net effect is to decrease the ionization rate and delay chemical equilibrium. Dissert. Abstr.

N68-35189# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

RISING REGGE TRAJECTORIES AND CROSSING SYMMETRY

S. Caser, J. M. Kaplan, and R. Omnes Jul. 1968 14 p refs

(TH/68/18) CFSTI: HC $3.00/MF $0.65

If there are infinitely rising Regge trajectories, the asymptotic behavior of the Regge pole terms in the s and t channels cannot be compatible with each other in the whole s,t plane. Thus the background integral cannot be neglected asymptotically if crossing symmetry is to be valid. This is in contradiction with the bounds obtained by KHURI on the behavior of the background integral out of the physical region. A mathematical example shows that these bounds cannot be extended outside the physical region. As a consequence of this, there does not remain any restriction either on the rate of increase of possible rising Regge trajectories except possibly a lower bound in $\sqrt{s}$ or in the behavior of the residue functions. Author

N68-35194 Northwestern Univ., Evanston, Ill.

A STUDY OF NEGATIVE KAON PROTON INTERACTIONS AT 4.1 AND 5.5 GeV/c: FINAL STATES INVOLVING TWO CHARGED PARTICLES WITH OR WITHOUT A VISIBLE Λ

Jack Edward Mott (Ph.D. Thesis) 1967 108 p

Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-15299

The results were obtained from a bubble chamber analysis of K−p interactions at incident K− momenta of 4.1 and 5.5 GeV/c. Emphasized was the analysis of two body final states such as elastic scattering and those containing an observed Λ (i.e., $\Lambda\rho^0$, $\Lambda\omega$, $\Lambda\eta$, ΛX^0, $\Lambda\phi$, $Y_1^*(1385)\,\pi^-$ and $Y_1^*(1680)\,\pi^-$). The elastic scattering differential cross section was found to be well described by the exponential form $d\sigma/dt = \exp(a + b|t| + ct^2)$ where t is the square of the four-momentum transfer. This exponential form has been found to be an accurate description of a large number of elastic processes with incident momenta ranging from 2 GeV/c to 19.8 GeV/c. The experimental data also showed no backward K− scattering in the K−p center of mass system.

Since backward peaks could arise from baryon exchange, this is consistent with the fact that there is no known baryon which could be exchanged in K−p elastic scattering. The most striking feature of the Λ final states is observation of a new resonance, namely the $Y_1^*(1680)$. Dissert. Abstr.

N68-35195 Nebraska Univ., Lincoln.
VARIATIONAL SOLUTIONS SATISFYING HYPERVIRIAL THEOREMS IN FIXED SOURCE BORON THEORIES
Donald Eugene McArthur (Ph.D. Thesis) 1967 70 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 67-15829

The Tomonaga intermediate coupling approximation for fixed-source boson theories is examined, and a necessary condition for its validity is given. Additional variational flexibility is introduced in such a way that a set of hypervirial theorems is automatically satisfied for the optimum choice of parameters. A procedure is given which allows the optimization to be carried out easily for the hypervirial theorems considered. It is well known that certain exact relations which are derivable from hypervirial theorems do not hold when the Tomonaga method is applied to fixed-source pseudoscalar meson theory. It is possible to modify the Tomonaga method in such a way that these exact relations are satisfied and the resulting reduced equation is not changed in form. The functional form of a modified ground-state eignefunction which satisfies these relations is given. A problem for which the Tomonaga method can be carried out numerically with no further approximation is considered in detail. Dissert. Abstr.

N68-35196 Tennessee Univ., Knoxville.
CALCULATION OF SPECTRAL LINE SHAPES AT GENERAL PRESSURES AND THE DETERMINATION OF INTERMOLECULAR POTENTIALS IN PRESSURES BROADENING EXPERIMENTS
Ronald Lee Fox (Ph.D. Thesis) 1967 106 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-15778

It is frequently asserted that information about intermolecular interaction potentials can be obtained from pressure broadened line shapes. The present work settles the question of how much information can be obtained if a certain set of experimental conditions are satisfied. A method of calculating spectral line shapes at arbitrary temperatures and pressures was developed. The analysis assumed: that the two body intermolecular potential is known; that the potentials add as scalars; that the perturbers follow classical paths determined by the equations of motion; and that collisions are adiabatic. The general pressures formula was studied first to determine the behavior of line shapes under conditions of pressure and temperature for which existing theories are not applicable. An approximate algebraic solution, applicable for high perturber densities, was obtained by expanding the correlation function as a power series in time. The general pressures theory was then studied as a set of coupled integral equations to determine whether the potential could be determined uniquely. It cannot. An attractive alternate is to assume a physically reasonable form (e.g., a Lennard–Jones potential) which contains undetermined parameters. Dissert. Abstr.

N68-35236# Princeton Univ., N. J. Elementary Particles Lab.
AN EXPERIMENTAL STUDY OF THE 2 NEUTRAL-PION DECAY OF THE LONG-LIVED NEUTRAL K-MESON
Paul C. Wheeler 14 Jun. 1968 151 p refs
(Contract N00014-67-A-0151)
(TR-47; AD-672919)

The 2 neutral-pion CP-violating decay of the neutral-K2-meson was studied in a recent experiment at the Princeton-Pennsylvania Accelerator. The energy spectrum of generated gamma-rays was obtained for the center-of-mass system of the neutral-K2 and used to measure the branching ratio (neutral-K2 to 2 neutral-pions)/(neutral-K2 to all modes). An upper limit of 0.0031 was obtained by normalizing to the neutral-K2 to 3 neutral-pion decay mode. Author (TAB)

N68-35306# Istituto Superiore Di Sanita, Rome (Italy). Laboratori Di Fisica.
ELASTIC AND QUASIFREE ELECTRON SCATTERING FROM C^{12} AND PROJECTED HARTREE–FOCK WAVE FUNCTIONS
S. Boffi (Pavia Univ.), C. Ciofi Degli Atti (S.C.K.-C.E.N., Mol-Donk, Belg.), and J. Sawicki (Trieste Univ.) 20 May 1968 21 p refs
(ISS-68/17) CFSTI: HC $3.00/MF $0.65

Projected Hartree–Fock wave functions are obtained for ^{12}C and ^{11}B using Volkov's force. The elastic electron scattering form factor and the angular and energy distributions for the high energy $^{12}C(e, e'p)$ reaction are calculated. While a good agreement is obtained with the observed elastic form factor, only a slight improvement over previous shell model results is obtained for the quasifree scattering data. The relatively large deformation of the Hartree–Fock field has only a negligible effect on the calculated form factors. Author

N68-35320# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
THREE BODY RESONANCES
J. L. Basdevant and R. Omnes Jul. 1968 23 p refs Presented at the Conf. on High Energy Phys., Vienna, 1968
(TH-68/22) CFSTI: HC $3.00/MF $0.65

It is shown that a pseudorelativistic three body theory derived on the basis of the Faddeev equations can be used to study three body resonances when the decay products resonate by pairs. The main virtues of the method, besides its simplicity, consist in having three body unitarity built in and in treating two body resonances as such in particle + resonance scattering. The limitations of the theory are discussed, and in particular it is shown that the ω meson cannot be examined in such a framework. Author

N68-35328# Illinois Univ., Urbana. Dept. of Physics.
NONRELATIVISTIC NUCLEAR REACTION KINEMATIC CROSSOVER ANGLES
Stephen I. Warshaw Jul. 1968 11 p refs
(Contract N00014-67-A-0305)
(AD-672932)

A nonrelativistic expression relating the bombarding energy to the laboratory angle at which the energies of reaction products from two dissimilar nuclear reactions coincide is derived and discussed. Applications to accelerator beam energy measurement, detector angular calibration, and nuclear reaction experiment planning are considered. Author (TAB)

N68-35369# Yeshiva Univ., New York. Belfer Graduate School of Science.
ON THE PROBLEM OF QUANTUM INTERFERENCE Final Report, 1 Mar. 1966–29 Feb. 1968
Yakir Aharonov and Aage Petersen Jun. 1968 36 p refs
(Contract AF 19(628)-5906)
(AFCRL-68-0338; AD-672986)

An approach is developed for the quantum interference problem that makes the characteristics of the problem more conspicuous and brings out the physical concepts which are adequate for its description. The idea of deterministic quantum experiments is introduced, and a deterministic quantum interference experiment is described. It is shown that the variables that are relevant for describing quantum interference are of the type cos(pl/h bar). The usefulness of these variables in the quantum theory of radiation is outlined. Author (TAB)

N68-35401# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

π-λ COUPLING CONSTANT AND LOW ENERGY π λ-$P_{3/2}$ WAVE SCATTERING

Chang-Chie Tsao, Chung-Yien Wang, and Ta-San Chan 25 Aug. 1967 11 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (China), v. 20, no. 12, 1964 p 1216–1220

(FTD-HT-66-508; AD-673196)

The paper points out that the improved Chew-Low expansion, when applied to pi-N(3,3) partial wave scattering, has succeeded in fitting the experimental data from the threshold up to energies above resonance. In this paper, the pi-Lambda-P3/2 wave is examined by the same method. TAB

N68-35414# Los Alamos Scientific Lab., N. Mex.

PHOTON CROSS SECTIONS FROM 0.001 TO 100 MeV FOR ELEMENT 1 THROUGH 100

Ellery Strom and Harvey I. Israel 15 Nov. 1968 257 p refs

(Contract W-7405-ENG-36)

(LA-3753) CFSTI: HC $3.00/MF $0.65

Tables are given of photon cross sections in the range 0.001 to 100 MeV for Z=1 to 100. Supplementary tables of mass attenuation coefficients for air, water, concrete, and sodium iodide; X-ray atomic energy levels; line energies; average energies; relative intensities; and fluorescence yields are also presented. Author (NSA)

N68-35452# Ballistic Research Labs., Aberdeen Proving Ground, Md.

PLUTONIUM BERYLLIUM NEUTRON SOURCE AS A SECONDARY CALIBRATION STANDARD

John A. Devanney Jun. 1968 36 p refs

(BRL-1401; AD-673108)

Plutonium-Beryllium (Pu-Be) neutron sources are calibrated with respect to total output, using a manganese-sulfate bath. When such sources are used as a point isotropic, secondary standard, inaccuracies occur due to the following reasons: (1) The neutron output is not isotropic, (2) the neutron output increases with time due to the build-up of Americium-241, resulting from the impurity of Plutonium-241, (3) the output spectrum is continuous from approximately 0.5 MeV to 10 MeV, (4) gamma rays exceed the number of neutrons emitted from the source. This report (1) presents the angular distribution of the neutron output of an 80 gram (4.81 curie) Plutonium-Beryllium neutron source, (2) shows that the increase in neutron output, due to the build-up of Americium-241 is 5.3 percent for a period of 43 months, (3) presents the neutron and gamma ray spectral distribution and intensity, (4) shows a neutron to gamma ray intensity ratio of 0.61:1 and a neutron to gamma ray dose (first collision-rads tissue) ratio of 9.36:1, (5) shows that a correction factor of 6.6 percent is required when the source is used as a point isotropic source of neutrons. Author (TAB)

N68-35469# Union Carbide Nuclear Corp., Oak Ridge, Tenn. Y-12 Plant.

A USERS MANUAL FOR HANDY

G. R. Handley and J. N. McLeod 19 Jun. 1968 18 p refs

(Contract W-7405-ENG-26)

(Y-1615) CFSTI: HC $3.00/MF $0.65

HANDY is a FORTRAN IV program which calculates the coefficients of the ten terms of the second-degree or quadric equation in three variables. A users manual is presented which describes in detail the format of the input data required; and, as an aid to understanding the data, the input and output of a sample problem are included. Author (NSA)

N68-35474# Los Alamos Scientific Lab., N. Mex.

A MODEL-BASED MASS LAW AND A TABLE OF BINDING ENERGIES

Philip A. Seeger and Robert C. Perisho 20 Oct. 1967 115 p refs

(Contract W-7405-ENG-36)

(LA-3751) CFSTI: HC $3.00/MF $0.65

A mass law is presented, based on the liquid-drop model with shell and deformation corrections given by the Nilsson model and pairing energy by the Bardeen–Cooper–Schrieffer model resulting mass law has 10 parameters, including all model parameters, and gives a standard deviation of 0.78 MeV when adjusted to the binding energies of 1127 known nuclei above mass 40. A table of binding energy, deformation, particle separation energies of protons, neutrons, and alpha particles, and Q-value for electron decay for over 9000 nuclides from Z = 22 to 120 and N = 22 to 200 is given in an appendix. Author (NSA)

N68-35495# Laboratoire de Physique Theorique Et Des Hautes Energies, Orsay (France).

A DERIVATION OF UPPER BOUNDS FOR FORWARD AND FIXED MOMENTUM TRANSFER SCATTERING AMPLITUDES AT HIGH ENERGIES

K. Chadan Jul. 1968 8 p refs

(Rept.-68/23) CFSTI: HC $3.00/MF $0.65

Continuous variables were used in the derivation of high energy upper bounds for forward and nearly forward (fixed momentum transfer) scattering amplitudes that satisfy the analyticity properties of axiomatic quantum field theory. The case of neutral scalar particles of equal mass was considered; and Omnès representation of the scattering amplitude was used to give a precise definition of the optical potential which, when used in the eikonal approximation, fits the scattering amplitude of high energies in the region where the diffraction peak is observed. M.W.R.

N68-35498# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.

QUARK MODEL COUPLINGS AND STRONG DECAYS OF TENSOR AND AXIAL MESONS

A. N. Mitra (Delhi Univ.) and Prem P. Srivastava 1968 10 p refs Submitted for publication Prepared in cooperation with the Intern. Centre for Theoret. Phys., Trieste *Its* Notas de Fis., Vol. 13, No. 14

CFSTI: HC $3.00/MF $0.65

The quark model couplings of tensor, axial and scalar mesons to PP and PV meson states have been evaluated under the assumption that the former have the $Q\bar{Q}$ structures $3_{P_{2,1,0}}$ and 1_{P_1}. The results for the strong decay widths for the known modes are in rather good agreement with observations. Author

N68-35503# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

RELATIVISTIC TWO-BODY PROBLEM WITH SEPARABLE INTERACTION

V. R. Garsevanishvili, V. A. Matveev, and L. A. Slepchenko 1968 16 p refs In RUSSIAN

(JINR-P2-3865)

The relativistic two body problem with separable interaction was considered. An exact solution of the problem for the factorizing kernel of the Bethe-Salpeter equation was obtained. The conditions were formulated, under which the Bethe-Salpeter equation and the corresponding quasipotential equation determine one and the same spectrum of the a stationary states of two particles. Author (NSA)

N68-35504# Stanford Univ., Calif. Linear Accelerator Center.
IONIZATION ENERGY LOSSES OF RELATIVISTIC PARTICLES
M. P. Lorikyan [1967] 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk Arm. SSR., Ser. Fiz. Mat. Nauk (Armenian SSR), v. 18, no. 6, 1965 p 109–111
(SLAC-TRANS-82) CFSTI: HC $3.00 MF $0.65

For relativistic particles passing from a vacuum into matter, the increase in ionization energy losses for different film thicknesses was used to determine the optimal thickness for which the polarization of the medium does not affect the ionization energy-losses in the thin boundary layer. Data for increase in electron energy losses from ionization in polystyrene are presented. NSA

N68-35515# Sandia Corp., Albuquerque, N. Mex.
THEORETICAL NEUTRON PRODUCTION FROM HYDROGEN ISOTOPE REACTIONS
J. A. Halbleib and M. R. Scott May 1968 98 p refs
(Contract AT(29-1)-789)
(SC-RR-68-19) CFSTI: HC $3.00/MF $0.65

A program is presented for calculating neutron production characteristics for the three hydrogen isotope reactions using hydrated titanium targets and incident ion energies up to 5 MeV. It is further suggested how the basic code, which will compute the neutron current density at an arbitrary point in space, may be modified to extend its usefulness. In particular, a demonstration is given for using the code to determine the neutron differential energy spectrum at an arbitrary spatial position. Author (NSA)

N68-35528# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE RETARDING PROPERTIES (MADE IN THE USSR) OF NUCLEAR PHOTOGRAPHIC EMULSIONS [O TORMOZNYKH SVOYSTVAKH VYPUSKAYEMYKH V SSSR YADERNYKH FOTOGRAFICHESKIKH EMUL'SIY]
A. P. Zhdanov and N. V. Skirda 11 Sep. 1967 31 p refs Transl. into ENGLISH from Zh. Nauch. i Priklad. Fot. i Kinematografii (Moscow), v. 10, no. 5, 1965 p 330–343
(FTD-MT-66-74; AD-673163)

Analysis of retarding properties of emulsions showed that Soviet-made emulsions do not completely satisfy contemporary requirements as a tool intended for quantitative investigations in nuclear physics. Some efforts on improvement are suggested. TAB

N68-35535*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TABLES OF ENERGY AND ANGULAR DISTRIBUTIONS OF THICK TARGET BREMSSTRAHLUNG IN METALS
Clemans A. Powell, Jr. Washington Oct. 1968 35 p refs
(NASA-TN-D-4755) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Calculations are made for the angular and energy distributions of bremsstrahlung produced in thick elemental metallic targets by normally incident monoenergetic fluxes of electrons with energies of 0.50, 0.75, 1.00, 2.00, and 3.00 MeV. Results are given for magnesium, aluminum, titanium, manganese, iron, nickel, copper, tungsten, gold, and lead. The target thickness was chosen to be the mean range of the electrons in the particular target material for the electron energy of interest. The theoretical analysis of these data is based on the approximation of a thick target by a series of thin slabs each of which is considered to be a thin target for bremsstrahlung production, and includes the following secondary processes: (1) the effect of multiple electron scatterings, (2) electron backscatter out of the target, (3) electron-electron bremsstrahlung, and (4) the absorption and buildup of photons in the target. Results are compared with experimental thick target bremsstrahlung data for aluminum and iron. Although the agreement is good, the predicted values tend to overestimate the experimental data for low photon energies and underestimate for higher photon energies. The discrepancy between the predicted and experimental values increases with increasing angular displacement from the incident electron direction and with increasing atomic number of the target material. Author

N68-35542# Oak Ridge National Lab., Tenn.
INELASTIC PARTICLE INTERACTION AT HIGH ENERGIES (COMPOSITION AND NUMBER OF SECONDARY PARTICLES)
V. S. Barashenkov, V. M. Maltsev, E. Patera, and V. D. Toneev [1967] 61 p refs Transl. into ENGLISH from the report JINR-P-2393
(ORNL-TR-1538-A) CFSTI: HC $3.00/MF $0.65

The results of many experiments in the high energy region of $T \geq 1$ GeV where the length of the DeBroglie waves of the colliding particles becomes smaller than their geometric dimensions and they begin to play a significant role in the effects connected with the internal structure of elementary particles, are gathered and analyzed without any preconceived theoretical models. The special case considered is the annihilation of antinucleons. In this case, even when the energy of the impinging antinucleon is very small, a large number of fast secondary particles can be produced. From this standpoint, the annihilation of antinucleous has very much in common with inelastic interactions in the presence of high energies, and the corresponding experimental data at all energies above $T \approx 0$. The basic characteristic of the interactions according to the number of produced particles and the composition of secondary particles. An important individual case is the probability of three-particle reactions. NSA

N68-35544# Technische Hochschule Stuttgart (West Germany). Inst. fuer Kernenergetik.
PLE: A PROGRAM FOR THE NUMERICAL SOLUTION OF THE MULTIGROUP P_L-EQUATIONS WITH ARBITRARY ANISOTROPIC SCATTERING FOR PLANE LAYERS
[1967] 56 p Transl. into ENGLISH from the GERMAN report
(ORNL-TR-1952) CFSTI: HC $3.00/MF $0.65

The mathematical formulation of an ALGOL program for the numerical solution of multigroup P_L equations with anisotropic scattering for plane layers is presented. NSA

N68-35547# Tokyo Univ. of Education (Japan). Physics Dept.
FINITE ENERGY SUM RULES FOR 10 + 10* AND 27 MESONS
Sunao Sakai Jun. 1968 14 p refs
(TUEP-68-14) CFSTI: HC $3.00/MF $0.65

The existence of 10 + 10* and 27 mesons are examined by studying forward scattering of octet pseudoscalar mesons off octet baryons under the hypothesis of SU(3) symmetry, the Regge pole theory, and the j-plane analyticity. Only 10 + 10* mesons with odd spin and only 27 mesons with even spin can couple with two octet pseudoscalar mesons. Concerning the parameters of the Regge poles associated with these mesons, it is found that one of the following three possibilities are realized: (1) $\alpha(0) < -1$ and $\beta(0)$ is not negligible; (2) $\beta(0)$ is small but $\alpha(0)$ is not small; and (3) there is no Regge poles in 10 + 10* and 27 states. Author

N68-35549# Montpellier Univ. (France).
ON THE ELECTROMAGNETIC PROPERTIES OF THE KAON
F. M. Renard Jun. 1968 28 p refs
(PM/68/2) CFSTI: HC $3.00/MF $0.65

The electromagnetic properties of the kaon are discussed in connection with those of the pion. The form factors are examined with the help of the unitary symmetry, quark model, vector dominance and polology. Their influence on the mass differences is then analyzed in the framework of the low energy phenomenology

for the virtual Compton scattering. For the kaon in addition to the elastic and inelastic terms the influence of the exchange in the t-channel of the $I = 1$ $\pi_V(1018)$ 0^+-meson is considered. The right sign and order of magnitude for δm_K is predicted using the quark model for the 0^+-γ-γ coupling. Author

N68-35550# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ON THE NUMBER-CONSERVING TREATMENT OF THE PAIRING INTERACTION
G. do Dang Aug. 1968 6 p refs
(TH-68/24) CFSTI: HC $3.00/MF $0.65

A method of solution by iteration is given in the number-conserving treatment of the pairing interaction. The solution is local in the sense that a single nucleus is involved in the calculations. Author

N68-35575# California Univ., Berkeley. Lawrence Radiation Lab.
REGGE POLES AND THE OCCURRENCE OF RESONANCES IN πN AND KN COLLISIONS [OBRAZOVANIYE REZONANSOV V πN I KN STOLKNOVENIYAKH I POLYUSA REDZHE]
A. B. Kaidalov and B. M. Karnakov [1967] 35 p refs Transl. into ENGLISH from the Report ITEF-520
(UCRL-TRANS-1364) CFSTI: HC $3.00/MF $0.65

The reactions of resonance production in πN and KN collisions at high energies are investigated within the framework of the Regge pole model. It is shown that existing experimental data on the differential cross sections and the polarization density matrix elements at the different energies are in good agreement with the predictions of the model of several Regge poles. The role of the possible branching in the complex j-plane is discussed. The analysis shows, that the contributions of branches having no definite parity are negligible in the energy region of <10 GeV. Author (NSA)

N68-35577# Oak Ridge National Lab., Tenn.
ANALYSIS OF NUCLEAR INTERACTIONS WITH ENERGIES OF $\geq 10^{12}$ EV BY MEANS OF PHOTOEMULSIONS
M. Miesowicz and T. Gierula [1967] 19 p refs Transl. into ENGLISH from the report, INR-814/VI/PH
(ORNL-TR-1956) CFSTI: HC $3.00/MF $0.65

Results of an analysis of interactions between nucleons of energies higher than 10^{12} eV and emulsion nuclei in two large emulsion stacks are presented. The main results of the emulsion work are presented from the point of view of the fire-ball model taking into account the possibility of the excitation of the nucleons. Author (NSA)

N68-35598# Akademiya Nauk USSR, Kiev. Inst. Teoreticheskoi Fiziki.
THE REDUCED PROBABILITIES OF ELECTRIC QUADRUPOLE TRANSITIONS IN EVEN-EVEN DEFORMED ATOMIC NUCLEI [PRIVEDENIE VEROYATNOSTI ELEKTRICHESKIKH KVADRUPOL'NYKH PEREKHODOV V CHETNOCHETNYKH DEFORMIROVANNYKH ATOMNYKH YADRAKH]
R. B. Begzhanov, V. M. Belen'kii, and S. L. Radovitskii 1968 74 p refs In RUSSIAN; ENGLISH Summary
(ITF-68-7)

In the framework of the well-known phenomenological theories of the atomic nucleus, the reduced probabilities of electric quadrupole transitions from the levels of the first anomalous rotational band of even-even nuclei are calculated. The results obtained are represented by a number of tables and graphs and are compared with experiment. Author (NSA)

N68-35605# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
WEINBERG SUM RULES AND THE RATIO F_K/F_π
Prem P. Srivastava 1968 17 p refs /its Notas de Fisica vol. 13, no. 13
CFSTI: HC $3.00/MF $0.65

The ratio F_K/F_π is derived using Weinberg's first spectral function sum rule in SU(3) $\times$ SU(3) while the second sum rule is used only in SU(2) $\times$ SU(2). Author

N68-35608# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
CHIRAL SYMMETRY, SUPERCONVERGENCE AND SUM RULES FOR SCATTERING AMPLITUDES
R. P. Saxena (Delhi Univ.), D. S. Narayan (Tata Inst. of Fundamental Res.), and Prem P. Srivastava 1968 6 p refs Submitted for publication Prepared in cooperation with the Intern. Centre for Theoret. Phys., Trieste /its Notas de Fis., vol. 13, no. 15
CFSTI: $3.00

Generalizing an idea of chiral symmetry being exact in an asymptotic limit, superconvergent sum rules are obtained for suitable combinations of scattering amplitudes. The predictions of the sum rules are compared with experiments. Author

N68-35624 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATION OF A NEW RESONANCE [ISSLEDOVANIE NOVOGO REZONANSA]
A. A. Kuznetsov [1968] 5 p Transl. into ENGLISH from Priroda (Moscow), no. 1, 1968 p 82-84
Available from Natl. Lending Library, Boston Spa, Engl

Short-lived particle resonances were considered in a study of processes whose decay products included certain hyperons and quanta. Some 200,000 photographs were taken of processes in a proton synchrotron using a propane bubble chamber set up in a constant magnetic field of 13.4 kOe, with the chamber irradiated by a beam of negative pi-mesons. Events were analyzed that yielded, in addition to the charged particle, a Λ^0-hyperon and at least one electron-position pair created by a γ-quantum. Effective mass calculations for such a system indicated peaks at 1190 MeV and 1350 MeV; the first decay could be explained in terms of a Σ^0-hyperon decaying into the Λ^0-hyperon and γ-quantum, while the second peak could not be interpreted in terms of any known particle. It was concluded that this second peak was due to an unknown resonance decaying into a Λ^0-hyperon and a π^0-meson, which in turn decayed into two $\gamma_2$quanta, one of which was measured by the bubble chamber. M.W.R.

N68-35628# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
ROCKET-BORNE DE/DX E SEMICONDUCTOR DETECTOR TELESCOPE FOR PARTICLE IDENTIFICATION
Tadayoshi Doke, Katsuaki Nagata (Rikkyo Univ.), Shigeo Nakagawa (Rikkyo Univ.), Akira Sasaki (Rikkyo Univ.), and Masahiro Tsukuda (Rikkyo Univ.) Jul. 1968 16 p refs
(ISAS-426, V. 33, No. 8) CFSTI: HC $3.00/MF $0.65

A particle identification method utilizing dE/dx-E products, including a discussion on the limitation of isotope separation for heavy charged particles, is described and a geometrical design of dE/dx-E counter telescope is presented. Based on these considerations, rocket borne instruments capable of observing the abundance ratio of protons, deuterons and tritons in the Van Allen belt were constructed. The system performance, the characteristics of the silicon dE/dx detectors, and the results of the rocket experiments are briefly described. Author

N68-35644# Japan Atomic Energy Research Inst., Tokyo.
ON THE EVALUATION OF PLUTONIUM 239 DATA IN THE KEV AND RESOLVED RESONANCE REGION
C. Durston and S. Katsuragi Jun. 1968 12 p refs
(JAERI-1162) CFSTI: HC $3.00/MF $0.65

The new evaluation for ^{239}Pu cross-sections in the keV region is described. The present evaluation gives a better interpretation to both the α-value and fission cross-section. This evaluation confirms the applicability of the channel theory of fission. In the resolved resonance regions a fit to the cross section is obtained suitable for use with the GENEX code. The resonance parameters are listed. Author

N68-35645# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
PHOTOPRODUCTION AND ELECTROPRODUCTION OF PIONS IN POLARIZED PROTON TARGETS
N. Zagury (Catholic Univ., Rio de Janiero) and A. F. F. Teixeira 1968 32 p refs Sponsored in part by Conselho Nacl. de Pesquisas, Brazil *Its* Notas de Fis., vol. 13, no. 18
CFSTI: HC $3.00/MF $0.65

The angular distribution of pions for photoproduction and electroproduction of pions in polarized proton targets is given. Using explicit values for the multipoles we have calculated this angular distribution in the case where the energy of the π-N system in their center of mass is 1236 MeV and for momentum transfers equal to zero (photoproduction) and -3, -6, and $-10f^{-2}$ (electroproduction). Author

N68-35656# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
CODE FOR THE CALCULATION OF MULTIGROUP CONSTANTS FROM A 26-GROUP SYSTEM OF MICRO-CROSS-SECTIONS
Peter Vertes 11 Jun. 1968 14 p refs
(KFKI-14/1968)

An algol procedure to calculate the multigroup constants from 26-group micro-cross sections is described. The tabulated micro-cross sections are written into magnetic tape backing store by special codes which are also discussed. The procedure is as simple as possible and needs a relatively small fast store. It has a short and a long version. In the latter, corrections are made for resonance self-shielding. Author (NSA)

N68-35664 National Lending Library for Science and Technology, Boston Spa (England).
A BREAKTHROUGH TO HIGH ENERGIES
Nikolai Bogolyubov 7 Aug. 1968 6 p Transl. into ENGLISH from Izv. (Moscow), 19 Jul. 1968
(M-7426) Available from Natl. Lending Library, Boston Spa, Engl.

A group of Dubna scientists has postulated theoretically and confirmed experimentally the possibility of building an accelerator on a new principle of collective acceleration of charged particles. The estimates of accelerating system parameters in such an installation show that its efficiency is much in excess of what can be achieved with the existing accelerators today. The scientist have scored a great achievement. Author

N68-35671# Tokyo Univ. of Education (Japan). Physics Dept.
LAGRANGIAN APPROACH TO INFINITE COMPONENT FIELD THEORY
H. Watanabe and S. Kamefuchi Jul. 1968 27 p refs
(TUEP-68-18) CFSTI: HC $3.00/MF $0.65

A Lagrangian formalism is constructed for a symmetric, trace-less tensor (spinor-tensor) of rank N which describes a multiplet with spin 0, 1, 2, . . . , N(1/2, 3/2, . . . N + 1/2). From physical quantities that are obtainable from this formalism we derive the corresponding quantities for an infinite multiplet with integer (half-integer) spin by means of an analytic continuation which changes the original field into a basis of an infinite dimensional, unitary representation of the Lorentz group. Feynman rules for infinite multiplets are determined in this way. Within this formalism mass spectra of infinite multiplets are always of the Majorana type, and the difficulties related to the spin-statistics theorem and spacelike solutions do not arise. Author

N68-35673# Oak Ridge National Lab., Tenn.
PROTON REACTION ANALYSIS FOR LITHIUM AND FLUORINE IN GRAPHITE, USING A SLIT SCANNING TECHNIQUE
R. L. Macklin, J. H. Gibbons, and T. H. Handley Jul. 1968 17 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2238) CFSTI: HC $3.00/MF $0.65

Protons from the ORNL 3-MV Van de Graaff accelerator were brought to a line focus and collimated through slits of either 0.025 or 0.0075 cm. Cross-sectional cuts of graphite samples were moved across the beam to study the distribution of Li and F with depth by measuring the yields of neutrons and of gamma rays from the reactions $^{7}Li(p,n)$ and $^{19}F(p,\alpha\gamma)$. A graphite sample exposed to molten fluorides in a loop experiment at the Oak Ridge Research Reactor showed about 20 and 100 ppM (by weight) Li and F respectively, 2 mm below the exposed surface. The observed ratio of Li to F was close to that characteristic of the molten salt down to 3 mm below the exposed surface. Author (NSA)

N68-35676# Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Laboratori Nazionali di Frascati.
ELASTIC SCATTERING AT LARGE MOMENTUM TRANSFERS
M. Greco 2 Jul. 1968 6 p refs *Its* Note No. 407
(LNF-68/40) CFSTI: HC $3.00/MF $0.65

A formula is given for the elastic p–p differential which is found to be in good agreement with the experimental data for high values of the momentum transfer t. This was derived from an expression which consists essentially of three factors: $P_{NB}(t)$ and $P_{NB}(t')$, which are defined as the probability that a proton does not break up when the momentum transfer takes the value t or t': $\int \exp[S(t) - S(t_o)]dt$, which represents the thermodynamical probability to realize a final state characterized by a value of the momentum transfer between t and t+dt. The entropy is S(t), an increasing function of t, which grows up with the different channels that are open; $S(t_o)$ is the maximum value of the entropy attained at $t = t_o$. A different approach is proposed for the possibility of connecting the p–p to the e–p scattering. This consists simply of identifying asymptotically the square of the electromagnetic form factor $G_{M_p}(t)$ with the probability $P_{NB}(t)$. Experimental data for the p–p differential cross reaction are plotted, and it is stressed that the connection between the electromagnetic and the strong structure of the proton seems to be strongly confirmed. M.G.J.

N68-35680# Idaho Nuclear Corp., Idaho Falls.
NEUTRON SCATTERING IN ORIENTED POLYETHYLENE AT 300, 77, AND 4.2°K
W. R. Myers May 1968 138 p refs
(Contract AT(10-1)-1230)
(IN-1151) CFSTI: HC $3.00/MF $0.65

The absolute neutron scattering cross sections of oriented polyethylene were measured at temperatures of 300, 77, and 4.2°K using the MTR phased chopper velocity selector. Incident neutron energies of 30, 40, and 80 MeV were used. The target was oriented so that the transverse and longitudinal cross sections could be measured simultaneously in six (three each) separate scattering angles. Data are presented in the form of absolute scattering cross sections and are also shown converted to the amplitude weighted directional frequency spectra. The conversion to

frequency spectra includes use of measured Debye–Waller coefficients. Strong singularities are observed at phonon energies of 65, 25, 15.5, 12, and 5.6 MeV. Data for all the angles at the three temperatures and three incident energies are tabulated. Author (NSA)

N68-35687# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
BARYON CURRENT ALGEBRA IN THE MODEL OF FREE EFFECTIVE QUARKS [ALGEBRA BARIONNYKH TOKOV V MODELI SVOBODNYKH EFFEKTIVNYKH KVARKOV]
V. P. Shelest 1968 19 p refs In RUSSIAN; ENGLISH summary (ITF-67-54)

It is proved that the commutation relations of the current algebra for baryons are valid in the model of free effective quarks to any order in the inverse baryon mass. Author (NSA)

N68-35690# Los Alamos Scientific Lab., N. Mex.
THE SCATTERING OF GAMMA RAYS IN AN EXPONENTIAL ATMOSPHERE
E. D. Cashwell, Conrad Longmire, and J. R. Neergaard Apr. 1968 39 p
(Contract W-7405-ENG-36)
(LA-3944) CFSTI: HC $3.00/MF $0.65

In studying the electromagnetic signal from the explosion of a nuclear device at high altitudes, a problem of importance is the determination of the time dependence of a gamma ray pulse as it undergoes Compton scattering in the earth's atmosphere. This report gives the results of Monte Carlo calculations designed to study this problem. Author (NSA)

N68-35702# International Centre for Theoretical Physics, Trieste (Italy).
MESON-BARYON AND BARYON–BARYON SCATTERING IN REGGEIZED U(6)×U(6) THEORY
R. Delbourgo and Harun-Ar Rashid Jun. 1968 21 p refs
(IC-68/43)

A complete set of rules is presented for evaluating the master meson trajector exchange contribution to high-energy scattering between mesons (M) and baryons (B) in U(6) ⊗ U(6) theory. The practical implementation of these rules is illustrated in considerable detail for quark-quark scattering as well as for 35W exchange to MB and BB charge exchange amplitudes. Author (NSA)

N68-35703# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
TRACK DENSITY MEASUREMENT IN DIELECTRIC TRACK DETECTORS WITH SCATTERED LIGHT
Warner W. Schultz Jan. 1968 13 p refs
(Contract W-31-109-ENG-52)
(KAPL-3412) CFSTI: HC $3.00/MF $0.65

Fission track densities in glass and in Lexan polycarbonate resin have been measured using light scattered from the tracks as a measure of the track density. Scattered light was found to be proportional to track density up to the point where tracks begin to overlap. For the two track detector materials tested, a scattering angle was found at which optimum signal-to-background ratios are obtained. Author (NSA)

N68-35717# Gulf General Atomic, San Diego, Calif.
INTEGRAL NEUTRON THERMALIZATION Quarterly Progress Report, Period Ending Mar. 31, 1968
J. R. Beyster, G. M. Borgonovi, and T. Gozani 15 Apr. 1968 40 p refs
(Contract AT(04-3)-167)
(GA-8626) CFSTI: HC $3.00/MF $0.65

The contribution of approximations to inaccuracies in a first principles calculation of the phonon dispersion curve for Be was analyzed. The scattering law for CH_2 was calculated, using a force constant model, in the incoherent approximation; the scattering law was used to calculate the double differential cross section. In addition, the total cross section for CH_2 was also calculated; the results agree with experimental data within 3%. A relation that is independent of Ewald's splitting parameter was derived for the Coulomb contribution to the dynamical matrix for UO_2, and shell-model formalism was applied to the lattice dynamics of BeO. A comparison of exact and short collision results for the scattering law of H_2O was made. Transmission measurements of the neutron total cross section of UC_2 were performed. A reanalysis of spectrum measurements across a Triga fuel element showed that an apparent extreme sensitivity to the spatial source distribution was spurious. A large rare earth detector that was developed for intermediate energy spectral measurements was calibrated by comparing it with other detectors and by the measurement of standard spectra. NSA

N68-35718# Polish Academy of Sciences, Warsaw.
CLASSICAL APPROACH TO QUANTUM AND WAVE PHENOMENA [KLASYCZNE PODEJSCIE DO PROBLEMU KWANTOWANIA I ZJAWISK FALOWYCH]
Michal Gryzinski 1968 5 p refs In POLISH; ENGLISH summary (INR-P-908/XVIII/PP)

It is shown that the inherent dependence between the translational motion of the electron and the motion of its spin axis—which results in appearance of the alternating component of the electric field—is the cause of "wave" phenomena and quantization of energy. Author (NSA)

N68-35742# Rochester Univ., N. Y. Dept. of Chemistry.
STUDIES OF NUCLEAR FISSION, LOW-ENERGY NUCLEAR REACTIONS, TRANSURANIC NUCLEI, AND GEO- AND COSMOCHEMISTRY Progress Report, 1 Sep. 1967–1 Jun. 1968
John R. Huizenga 1 Jun. 1968 29 p refs
(Contract AT(30-1)-3938)
(NYO-3938-1) CFSTI: HC $3.00/MF $0.65

The determination of nuclear level densities from excitation functions of isolated levels was investigated using the reactions ^{59}Co9p,α) ^{56}Fe(α,p) ^{59}Co, ^{58}Mn(p,α) ^{62}Ni(p,α) ^{59}Co. The [743↓] Nilsson configuration in ^{237}U was identified by a study of the reaction ^{238}U(^{3}He,α)^{237}U. Transition states in odd-A nuclei were investigated by measuring fission-fragment angular distributions and corss sections for neutron fission of ^{232}Th as a function of neutron energy and by measuring fission-fragment angular distributions for neutron fission of ^{234}U. An interpretation of the fission-fragment angular distributions in deuteron fission of ^{209}Bi at moderately-large excitation energies was proposed. NSA

N68-35743# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
MESON PHOTOPRODUCTION BY POLARIZED GAMMA RAYS AND THE PRIMAKOFF EFFECT [FOTOROZHDENIE MEZONOV POLYARIZOVANNYMI FOTONAMI I EFFEKT PRIMAKOVA]
L. I. Lapidus and M. M. Musakhanov 1968 8 p refs In RUSSIAN; ENGLISH summary Submitted for publication
(JINR-P2-3845)

It is shown that experiments on the Primakoff effect on a spinless nucleus with polarized photons, give better possibilities to select contributions of coherent and noncoherent processes with an excited nucleus which has a nonzero spin value in final states. This gives new possibilities to make improvements in measurement of the η-meson lifetime. Author (NSA)

N68-35761# Rochester Univ., N. Y. Physics and Astronomy Dept.
EFFECTIVE INTERACTIONS IN NUCLEI AND TWO NUCLEON SCATTERING

Daniel S. Koltun 14 May 1968 13 p refs Presented at the 3d Intern. Symp. on the Struct. of Low-Medium Mass Nuclei, Kansas, Apr. 1968
(Contract AT(30-1)-875)
(UR-875-234) CFSTI: HC$3.00/MF$0.65

Several ways in which the residual interaction can be related to two-body scattering are discussed. The residual interaction is considered to split shell-model states of a given configuration and is defined to be an effective two-body interaction. NSA

N68-35772# Oak Ridge National Lab., Tenn.
SENSITIVITY OF NEUTRON TRANSPORT IN OXYGEN TO VARIOUS CROSS-SECTION SETS
E. A. Straker 26 Jun. 1968 23 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2252) CFSTI: HC$3.00/MF$0.65

The effect of several input cross-section sets on the results of neutron transport in an infinite medium of oxygen is determined. The detail with which the minimum in the corss section is represented significantly affects the neutron intensity at deep penetration. The importance of using angular distributions and total cross sections determined with approximately the same energy resolution is demonstrated by results obtained by combining parts of two different cross-section sets. In addition, the effect of various amounts of smoothing of the input cross sections over energy is also shown. In general, the slope of the $4\pi R^2$ dose curves at deep penetration is determined by the minimum in the total cross section as used in the code. Author (NSA)

N68-35780# Tokyo Univ. of Education (Japan). Physics Dept.
THE ELECTROMAGNETIC MASS DIFFERENCE OF K MESON DUE TO A SIMPLIFIED TADPOLE AND PION YIELD 2 GAMMA
Kimio Miura [1968] 4 p refs
(TUEP-68-19) CFSTI: HC$3.00/MF$0.65

A tadpole model is used to study the electromagnetic mass difference (emd) for the K meson. The field current identity hypothesis by using a current-mixing model and SU(6) unitarity are assumed in an effort to show that the simplified tadpole contributes negatively to the end. Interaction Hamiltonians are given, with the relative phase between two of the coupling constants determined from SU(6) and between two others fixed from SU(3). Decay rate is found, an expression is given for the kaon mass, and the negative contribution of the tadpole is shown to be small. M.W.R.

N68-35795# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
INVESTIGATION OF WATER MOLECULES DYNAMICS IN CRYSTALLOHYDRATES BY INELASTIC NEUTRON SCATTERING
A. Bajorek, J. A. Janik, J. M. Janik, I. Natkaniec, K. Parlinski et al Apr. 1968 37 p refs
(INP-601/PS)

Translatory and rotatory frequencies of water of crystallization molecules were determined by the inelastic neutron scattering method in several crystallo-hydrates. The results were compared with those obtained from IR and NMR experiments. Author (NSA)

N68-35796# United Kingdom Atomic Energy Authority, Harwell (England). Solid State Physics Section.
MOLECULAR DYNAMICS OF METHANE IN ARGON
O. J. Eder (Oesterr. Studienges. fuer Atomenergie, Seibersdorf) and P. A. Egelstaff 1968 17 p refs Presented at IAEA Conf., Copenhagen, May 1968
(SGAE-PH-65/1968)

Inelastic and quasi-elastic scattering of 5.3-Å neutrons was studied for the system methane in argon at 86°K. Experimental data were taken for two concentrations (1.6 and 3.2 molar %), and six scattering angles. A discussion of the changes in the scattering pattern as compared to scattering experiments on pure methane performed under comparable conditions is presented. Using a new approach for the rotational motion of the methane molecules, a comparison with experimental data is made, assuming the methane molecule to rotate nearly freely at short times and undergo rotational diffusion at long times, while discussing the center-of-mass motion in terms of a modified "itinerant oscillator" model. The data are consistent with the view that the argon atoms form a "cage" around the methane molecules in which the rotation is continuously but weakly hindered and where the longtime translational motion can be described by simple diffusion, while for the shorttime behavior some new approach is needed. Author (NSA)

N68-35799# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SUPERCONDUCTIVITY IN THE QUARK MODEL AND REGGE TRAJECTORIES [SVERKHPROVODIMOST'V MODELI KVARKOV I TRAEKTORII REDZHE]
Yu. M. Malyuta 1968 8 p refs In RUSSIAN
(JINR-P2-3802)

It is shown that reggeons, representing two families of baryon resonances (N(1525−), N(2190−), N(2650−), N(3030−)), and (Δ(1236+), Δ(1920+, Δ(2420+), Δ(2850+), Δ(3230+)), are the states of superconductive type, which are constructed of three quarks with zero masses. Author (NSA)

N68-35802# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ON THE BREMMSTRAHLUNG AMPLITUDE BY NUCLEON COLLISONS [OB AMPLITUDE TORMOZNOGO IZLUCHENIYA PRI SOUDARENII NUKLONOV]
A. V. Tarasov 1968 19 p refs In RUSSIAN
(JINR-P2-3803)

The general form of the nucleon–nucleon bremsstrahlung (NNB) amplitude was determined. Restrictions on scalar amplitudes resulting from parity conservation are discussed. In the Low approximation NNB amplitudes are expressed in terms of NN-scattering amplitudes. Author (NSA)

N68-35803# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
BREMSSTRAHLUNG BY NUCLEON COLLISIONS IN THE LOW APPROXIMATION
A. V. Tarasov 1968 17 p refs In RUSSIAN
(JINR-P2-3830)

The observed values of the process NN → NNγ(NNB) are expressed in the Low approximation by the values of elastic NN-scattering. It is shown that the components of any polarization tensor in the NNB are expressed only in terms of the components of analogous polarization tensor in the NN-scattering and their derivatives. Imitation of the T-noninvariant effects in the NN-scattering by the bremsstrahlung is discussed. Author (NSA)

N68-35804# Comision Nacional de Estudios Atomica, Buenos Aires (Argentina).
NUMERICAL CALCULATIONS OF THE ENERGY LEVELS OF ASYMMETRIC EVEN NUCLEI DUE TO ROTATIONS AND BETA AND GAMMA VIBRATIONS [CALCULO DE LOS NIVELES DE ENERGIA DE NUCLEOS PARES ASIMETRICOS DEBIDOS A ROTACIONES Y VIBRACIONES BETA Y GAMMA]
J. F. Suarez and E. Y. De Aisenberg 1967 16 p refs In SPANISH
(CNEA-207)

The dependence of collective excitations in even nuclei on the parameters of the Davydov model was investigated. The results are presented in graphical and tabular form. NSA

N68-35813# Tokyo Univ. (Japan). Coll. of General Education.
ON A DOUBLE PEAKED STRUCTURE IN RESONANCE SCATTERING
Yasunori Fujii and Masaaki Kato Jul. 1968 11 p refs
CFSTI: HC $3.00/MF $0.65

The S wave scattering of two spinless particles above the inelastic threshold is considered, with the behavior of the elastic S matrix element given approximately by its poles and zeroes located near the real axis in the complex s plane. The s plane is part of the whole Riemann surface, which in the case of two-channel two-particle reactions consists of the upper half of the physical (or first) sheet and the lower half of the third sheet. The position of the two poles is considered as are possible positions of the zeroes; and this results in total elastic cross sections with two peaks. This double peaked structure is discussed, as is the production process of the A_2 meson. A possible model of resonance scattering is mentioned. M.W.R.

N68-35819# Commissariat A L'Energie Atomique, Saclay (France). Centre D'Etudes Nucleaires.
THE C_N METHOD FOR APPROXIMATION OF THE BOLTZMANN EQUATIONS
Pierre Benoist and Alain Kavenoky Jan. 1968 46 p refs In FRENCH
(CEA-R-3170)

In a new method of approximation of the Boltzmann equation, one starts from a particular form of the equation which involves only the angular flux at the boundary of the considered medium and where the space variable does not appear explicitly. Expanding in orthogonal polynomials the angular flux of neutrons leaking from the medium and making no assumption about the angular flux within the medium, very good approximations to several classical plane geometry problems, i.e., the albedo of slabs and the transmission by slabs, the extrapolation length of the Milne problem, and the spectrum of neutrons reflected by a semi-infinite slowing-down medium. The method can be extended to other geometries. Author (NSA)

N68-35821# International Centre for Theoretical Physics, Trieste (Italy).
ARGAND DIAGRAMS AND RESONANCES
V. A. Alessandrini, P. G. O. Freund, R. Oehme, and E. J. Squires Jun. 1968 11 p refs
(IC-68/51)

It is shown that the Argand analysis of Regge amplitudes would give rise to "resonances" with low masses and high spins if the interpretation of maxima as resonances were accepted. Theoretical and experimental consequences are discussed. Author (NSA)

N68-35830# Oak Ridge National Lab., Tenn.
A COMPARISON OF NON-RELATIVISTIC HARTREE-FOCK CALCULATIONS FOR SELECTED ATOMS AND IONS
C. W. Nestor, Jr. 13 Jun. 1968 13 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2251) CFSTI: HC $3.00/MF $0.65

This memorandum is a collection of the results of several recent Hartree–Fock calculations of electronic wave functions, one-electron energies, total energies and expectation values of powers of r, for the atoms fluorine, neon, chlorine and argon and for the neutral atom and several ions of bromine. Results from two analytic Hartree–Fock calculations and two numerical Hartree–Fock calculations were included in the tabulation, and good agreement between them for one-electron and total energies was found. As might be expected, the agreement is good for the expectation values of small powers of r and becomes worse for the larger powers of r. Author (NSA)

N68-35834# Atomic Energy Commission, New York. Health and Safety Lab.
A MONTE CARLO PROCEDURE FOR CALCULATION OF THE EXTRANUCLEAR CASADE
Harold L. Beck, Burton G. Bennett, and Keran O'Brien Jun. 1968 12 p ref
(HASL-192) CFSTI: HC $3.00/MF $0.65

As a first step toward attacking the problem of the cosmic ray cascade in the atmosphere, a Monte Carlo procedure is devised which is unique in its simplicity in describing the cascade process which, when supplemented by statistical estimation gives results at depths of 1000 g/cm^2 with a small number of histories. In order to test its validity, results obtained by this method are compared with an analytical solution choosing a cascade model for its solvability which has many of the properties of the extranuclear hadron cascade. Author (NSA)

N68-35832# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
REAL PART OF THE ELASTIC πN- AND NN SCATTERING AMPLITUDE
V. S. Barashenkov and V. D. Toneev 1968 8 p ref In RUSSIAN
(JINR-P2-3850)

Graphs are given of the energy dependence of the ratio of real and imaginary parts for the elastic $\pi^+ + p$, $\pi^- + p$, $p + n$, and $p + p$ scattering amplitudes at zero angle in the energy range from 50 MeV up to 200 GeV. Author (TAB)

N68-35835# International Centre for Theoretical Physics, Trieste (Italy).
CONTINUOUS-PARAMETER SUM RULES
M. O. Taha Jun. 1968 16 p refs
(IC-68/48)

Using Laplace transform and Regge high-energy behavior, continuous-parameter sum rules are found for strong interaction amplitudes. The finite-energy version of these sum rules is discussed and equations for the Regge parameters obtained. Forward πN scattering is considered as an example and numerical values are found for the parameters of ρ and ρ' trajectories. A mathematical appendix on the incomplete gamma function is added. Author (NSA)

N68-35838# Edgerton, Germeshausen and Grier, Inc., Goleta, Calif.
MEASUREMENT OF LINAC THICK-TARGET BREMSSTRAHLUNG SPECTRA USING A LARGE NAI SCINTILLATION SPECTROMETER
C. W. Sandifer and M. Taherzadeh 1968 18 p refs Presented at the Ann. Conf. on Nucl. and Space Radiation Effects, Missoula, Mont.
(Conf-680706-1) CFSTI: HC $3.00/MF $0.65

Thick-target bremsstrahlung spectra produced by electron bombardment of a 0.2 radiation-length gold–tungsten target were measured for electron energies in the range of 5.3 to 20.9 MeV. A large NaI spectrometer coupled to a pulse pile-up rejection system measured pulse-height distributions for bremsstrahlung emitted in the forward direction, and a response matrix developed for the spectrometer was used to convert the pulse-height distributions into photon energy spectra. The shapes of the measured spectra show good agreement with those obtained by others for the same target configuration. Apparatus and experimental methods are described and thick-target bremsstrahlung spectra are presented for electron energies of 5.3, 10.0, 14.8, 16.4, 18.2, and 20.9 MeV. Author (NSA)

N68-35841# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
PHOTOPRODUCTION OF MESON AND BARYON RESONANCES AT ENERGIES UP TO 5.8 GEV
R. Erbe, H. G. Hilpert, and E. Schuettler May 1968 110 p refs
(DESY-68/8)

In a study of photoproduction at photon energies between 0.3 and 5.8 GeV in a hydrogen bubble chamber approximately 31,000 events with three, five, or seven outgoing charged particles were analyzed. A survey is given of the experimental procedures and of resonance production in quasi-two-body reactions. The cross sections for the processes were measured as a function of the photon energy. The differential cross sections and density matrix elements are given for various intervals of the photon energy. The photoproduction of vector mesons and Δ isobars is discussed in terms of several models. Author (NSA)

N68-35848# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
CONTRIBUTION TO THE STUDY OF NUCLEAR STRUCTURE USING NEUTRON TOTAL CROSS-SECTION MEASUREMENTS BETWEEN 400 AND 1200 KeV: ISOLATED RESONANCES AND INTERMEDIATE STRUCTURE [CONTRIBUTION A L'ETUDE DE LA STRUCTURE NUCLEAIRE PAR DES MESURES DE SECTIONS EFFICACES NEUTRONIQUES ENTRE 400 keV ET 1200 keV: RESONANCES ISOLEES ET STRUCTURE INTERMEDIAIRE]
Jean Cabe (Ph.D. Thesis—Paris Univ., France) 30 Jun. 1967 136 p refs In FRENCH
(CEA-R-3279)

The neutron total cross sections were measured over the energy range 400 to 1200 keV for fluorine, aluminum, silicon, phosphorus, vanadium, chromium, manganese, iron, nickel, cobalt, and lead with an energy spread of 3 keV. The neutrons were produced by the T(p,n)^{3}He reaction; the proton beam was supplied by a 2-MeV Van de Graff. The structure in ^{56}Fe was studied in a more detailed way be measuring six angular distributions in the above range and the elastic scattering excitation curves at four angles. The measurements have made it possible to show the existence of the compound nucleus, as well as the presence of an intermediate structure in certain nuclei. Author (NSA)

N68-35849# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
LECTURES IN QUASICLASSICS [LEKTSII PO KVAZIKLASSIKE]
L. I. Ponomarev 1967 79 p refs In RUSSIAN; ENGLISH summary
(ITF-67-53)

On the basis of the Zwaan method which was previously developed and using a Kemble's idea, typical problems of the Wentzel-Kramers-Brillouin method are discussed in detail and several new problems of the quasiclassics are solved. Special attention is paid to the method by which quantum mechanical equations should be reduced to the quasiclassical form. Some practical prescriptions are foumulated for applying the WKB method. Author (NSA)

N68-35849# Tokyo Univ. of Education (Japan). Physics Dept.
THE P-N MASS DIFFERENCE BASED ON THE REGGEIZED TADPOLE MODEL
Kimio Miura and Tsunetoshi Watanabe Jul. 1968 13 p refs
(TUEP-68-18) CFSTI: HC $3.00/MF $0.65

Based on the Reggeized Tadpole model and using the two generalized superconvergence relations $A_2(1300)$ and $\pi_v(1016)$ for Regge poles, the p-n mass difference $\Delta m(p\text{-}n) \simeq 0.62$ MeV is estimated from a low energy diagram with nucleon pole domination. As high energy contribution is obtained $\Delta m^H(p\text{-}n) \simeq -0.1$ MeV from the A_2 trajectory contribution, and $\Delta m^H(p\text{-}n) \simeq -0.07$ MeV from the π_v trajectory. The final result is $\Delta m(p\text{-}n) \simeq 0.45$ MeV, which is in disagreement with experiment $\Delta m_{exp}(p\text{-}n) = -1.3$ MeV. Author

N68-35851# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
σ-MODEL AND EQUAL TIME CURRENT-CURRENT COMMUTATORS IN THE PERTURBATION THEORY
N. I. Usyukina 1968 18 p refs In RUSSIAN
(JINR-P2-3827)

Simultaneous commutation relations of vector and axial vector currents are investigated for σ-model in the framework of the perturbation theory. The operator and isotopic structure of noncanonical members in the current commutators for equal times is considered. Author (NSA)

N68-35852# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ELECTRIC DIPOLE MOMENT OF SPINOR PARTICLES AND ELECTROMAGNETIC CP-VIOLATION
A. T. Filippov, Z. Oziewicz, and A. Pikulski 1968 10 p refs
(JINR-E2-3801)

It is shown that there exists the possibility of construction of CP-noninvariant P-conserving electromagnetic interaction in such a way that the neutron electric dipole moment is of the order 10^{-23} e.cm which does not contradict the recent experimental data. Author (NSA)

N68-35853# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INTERACTION OF QUASIPARTICLES WITH PHONONS IN DEFORMED NUCLEI
V. G. Solov'ev 1968 27 p refs In RUSSIAN
(JINR-P4-3903)

The effect of the quasiparticle-phonon interaction on the structure of ground and excited nonrotational states of deformed nuclei is studied. It is shown that by increasing the excitation energy the structure of quasiparticle states becomes more complicated, i.e., the role of admixtures increases. Author (NSA)

N68-35854# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
ANGULAR CORRELATIONS OF GAMMA CASADES IN ^{155}GD
A. Z. Hrynkiewicz, J. Kisielewski, Z. Stachura, J. Styczen, M. Szawlowski et al 1968 8 p refs
(JINR-E6-3906)

Angular correlations measurements, with Ge(Li) and NaI(Tl) detectors working in coincidence, were performed for several gamma cascades present in the decay of ^{155}Tb. Results obtained for the 86.6 keV and 105.3 keV excited states in ^{155}Gd corroborate the previous spin assignments. For the states at 235.2, 266.6, 367.7, and 427.3 keV, the analysis of the angular correlation coefficients for the corresponding cascades leads to the spin values 3/2 (7/2), 5/2 (1/2, 5/2), and (3/2, 7/2), respectively. Author (NSA)

N68-35856# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SINGLE-PARTICLE LEVELS OF A FINITE DEFORMED POTENTIAL
V. V. Pashkevich and V. M. Strutinskii 1968 17 p refs In RUSSIAN
(JINR-P2-3857)

A method is presented for calculations of a single-particle energy spectrum and wave functions of a Hamiltonian with a

finite axially symmetric diffused potential. The wave functions are expanded in the eigenfunctions of a deformed harmonic oscillator. High efficiency of the method was achieved due to the proper choice of the basis for every deformation and rational calculation of the matrix elements. The energies of both bound and quasistationary states can be calculated. Author (NSA)

N68-35863# Jagellonian Univ., Cracow (Poland). Dept. of Theoretical Physics.
SIMPLE METHOD OF PRESENTING JOINT DECAY DISTRIBUTIONS FOR PAIRS OF RESONANCES
A. Kotanski and K. Zalewski (Polish Acad. of Sci., Cracow) Sep. 1967 27 p refs
(TPJU-15/67)

Statistical tensors are used to describe decay distributions of resonances and joint decay distributions of pairs of resonances. General formulas are derived and their use is illustrated by examples (for ρ, N^*, ρN^*. Author (NSA)

N68-35864# Jagellonian Univ., Cracow (Poland). Dept. of Theoretical Physics.
SYSTEMATICS OF THE RELATIONS FOLLOWING FROM THE QUARK MODEL 2. CONSTRAINTS ON DECAY DISTRIBUTIONS OF RESONANCES
A. Bialas and K. Zalewski (Polish Acad. of Sci., Cracow) Dec. 1967 26 p refs
(TPJU-19/67)

Decay distributions of the resonances produced in quasi-two-body processes are discussed in the framework of the generalized quark model. Only results which can be obtained without comparing different reactions are considered. The quark model relations among density matrix elements are divided into three groups differing in their behavior under changes of the spin reference frames. The relations contained in the first two groups are found to be consistent with the experimental data. The relations from the third group seem in disagreement with the data. A tentative interpretation of these results is given. Author (NSA)

N68-35865# Atomic Energy Commission Research Establishment, Riso (Denmark).
ERROR INDICATORS FOR THE NUMERICAL SOLUTION OF NON-LINEAR WAVE EQUATIONS
O. Kofoed-Hansen Mar. 1968 36 p refs
(RISO-177)

A methodical approach to the problem of error accounting during numerical solution of non-linear wave equations considered as initial value problems is presented. The errors resulting from numerical differentiation are described by the term average modal error indicators. The errors consist of round-off errors, which are treated statistically, and truncation errors, which are treated analytically by the usual methods. The error resulting from integration procedures is described by an error accumulation equation carried parallel to the development of the solution. Source terms for this equation are derived by means of the average modal error indicators for differentiation combined with the coefficients in the expansion and the remainder terms omitted by the truncation of the Taylor expansion. This truncation is also used for the determination of the (variable) step length along the path of integration. A series of simplification are introduced in order to facilitate the error accounting, and practical procedures are described. Author (NSA)

N68-35898# Princeton Univ., N. J.
HIGH ENERGY MOLECULAR BEAMS Final Report, 1 Mar. 1964–31 Aug. 1967
James B. Anderson Jan. 1968 18 p refs
(Contract AF19(628)-3887)
(AFCRL-68-0189; AD-673522)

A description of research on producing high energy molecular beams is given. Results of previously published work are summarized for the development of techniques for generating neutral beams in the 1 to 10 eV range using gas dynamic acceleration of heavy species by light carrier gases in nozzle flows from which molecular beams are extracted. Measurements of heavy species velocities, velocity distributions and intensities in the molecular beams formed are discussed in relation to theoretical predictions. Studies of the gas dynamics of free jets of pure gases and mixtures used as molecular beam sources are reported. A brief assessment of applications to research on atomic and molecular collision processes is included. Author (TAB)

N68-35898# Columbia Univ., New York. Radiation Lab.
RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM Progress Report, 1 Nov. 1967–30 Apr. 1968
Robert Novick 30 Apr. 1968 100 p refs
(Contract DA-28-043-AMC-00099(E))
(CU-4-68-AMC-00099-Phys.; PR-17; AD-673141)

Contents: Atomic physics (Metastable atoms and ions, Level-crossing and optical double-resonance spectroscopy, Collision phenomena, Atomic frequency standards); Physics of molecules (Beam maser spectroscopy, Electron excitation of molecular hydrogen, Scattering of velocity selected molecular beams, Magnetic rotation spectra, Molecular spectra of cesium and rubidium, Laser studies of molecular birefringence and optical activity, Optical laser spectroscopy of fluids); Solid state physics (Interaction between a neutral beam and a conducting surface, Adiabatic demagnetization in the rotating frame, Nuclear magnetic resonance in fine particles, Photon-echo resonance, Echo behavior in ruby); X-ray astronomy (X-ray polarization, X-ray telescope). TAB

N68-35910# Phillips Petroleum Co., Idaho Falls, Idaho.
FISSION COUPLE CRYOGENIC APPLICATIONS FEASIBILITY STUDY
M. L. Stanley Jun. 1968 40 p refs
(Contract AT(10-1)-205)
(IDO-17268) CFSTI: HC$3.00/MF$0.65

The problem of fission couple application at cryogenic temperatures is investigated with consideration given to heat generation per fission, fissile size, gamma compensation, burnup, radiation hazard, heat losses, and signal output at various neutron flux levels. Models are developed using simple one-dimensional heat transfer theory, and maximum signal outputs are calculated as a function of neutron flux levels. The variation in thermal conductivity with temperature is included in the analysis. The conclusion is reached that fission couples are applicable at cryogenic temperatures when heat loss is a major part of their design criteria. Author (NSA)

N68-35918# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
TWO-DIMENSIONAL EXPANSIONS OF RELATIVISTIC AMPLITUDES, REGGE TRAJECTORIES, AND DAUGHTER POLES
M. Shefel, J. Smorodinsky, and P. Winternitz 1968 28 p refs
(JINR-E2-3841)

The two-dimensional expansions of the relativistic amplitudes for binary scattering processes are discussed with respect to both independent kinematical parameters over the irreducible representations of the O(3,1) group. The connection of these expansions with the Regge pole theory as well as with that of the Toller poles is investigated. The consequences concerning the problem of existence of daughter trajectories are also considered. Author (NSA)

N68-35929# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ELECTROMAGNETIC MASS DIFFERENCE OF KAONS
B. V. Struminskii and G. M. Zinovjev 1968 7 p refs
(JINR-E2-3853)

The electromagnetic K-meson mass difference was calculated on the basis of the finite energy sum rules for the virtual Compon effect amplitude. Author (NSA)

N68-35951# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Festkoerper- und Neutronenphysik.
THE KIRKENDALL EFFECT THEORY [THEORIE DES KIRKENDALL-EFFEKTS]
Josef Schlipf May 1968 54 p refs in GERMAN
(JUL-527-FN) CFSTI: HC $3.00/MF $0.65

A self-consistent, complete theory of the Kirkendall effect is presented which differs from the ideal Kirkendall effect as described by the Darken equations. The phenomenological part of the theory contains an approximation method that permits explicit calculation of the vacancy concentration and the shift velocity in the diffusion zone. It is shown that deformation zones occur in the border areas of the diffusion zone of silver-gold diffusion pairs which have an induced Kirkendall effect of the same order of magnitude as the diffusion zone. Plastic deformation decisively affects the onset of the Kirkendall effect. The extent of the plastic deformation in the entire area of concentration is calculated, and a simple interrelation is shown to exist between the shift velocity of the markings and the deformation velocity. The effects of microcracks and of inhomogeneous diffusion deformation on the deformation zones are examined as well as the connection between the formation of cracks and pores. Transl. by K.W.

N68-35976# Montpellier Univ. (France).
INTERNATIONAL PROPERTIES OF THE ELECTROMAGNETIC CURRENT IN BROKEN UNITARY SYMMETRIES
Fernand M. Renard Apr. 1968 15 p refs
(PM/68/1) CFSTI: HC $3.00/MF $0.65

Broken symmetry treatments for U-spin and SU(3) are discussed using concepts of group theory and algebra of currents theory, and the equivalence of the two methods is verified. Broken U-spin and SU(3) relations are considered; for the former it is assumed that the photon is a U- spin scalar, while for the latter it is shown that the same physical amplitudes or coupling constants result whether the electromagnetic current is the sum of parts of an SU(3) scalar and the Q member of an octet or if it is solely the Q member of an octet. Hadron form factors and radiative transitions are discussed for both U-spin and SU(3); and baryon form factors and V–γ couplings are evolved in connection with the possible determination of one of the components of the electromagnetic current. M.W.R.

N68-35977# Centro Brasiliero de Pesquisas Fisicas, Rio de Janeiro.
SUPERCONVERGENT SUM RULE FOR PION PHOTOPRODUCTION ON NEUTRAL LAMBDA HYPERONS
P. P. Srivastava 1968 7 p refs Supported in part by Guggenheim Mem. Found. *Its* Fis. Notas Vol. 13, No. 16
CFSTI: HC $3.00/MF $0.65

A superconvergent sum rule for the photoproduction of pions on Λ^0 was obtained that is in fair agreement with sum rules recently obtained for photoproduction of pions on nucleons. The invariant amplitude in the photoproduction process can be decomposed into four invariant amplitudes; and these are functions of the two invarients containing the momenta of the photon, meson, and initial and final baryons. It is assumed that the high energy behavior of each amplitude is determined by the leading Regge trajectory that can be exchanged in the t-channel. The pole term contribution to the integral due to the intermediate state is readily evaluated while the continuum contribution may be evaluated using an isobaric model. Decays are calculated, and SU(3) symmetry leads to a relation between the total proton magnetic moment thus obtained and the transition magnetic moment. M.W.R.

N68-35978# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
A NEW CLASS OF SUPERCONVERGENT SUM RULES FOR SCATTERING AMPLITUDES
D. S. Narayan (Tata Inst. of Fundamental Res.), R. P. Saxena (Delhi Univ.), and Prem P. Srivastava 1968 9 p refs Prepared in cooperation with the Intern. Centre for Theoret. Phys., Trieste *Its* Notas de Fis., Vol. 13, No. 17
CFSTI: HC $3.00/MF $0.65

Sum rules obtained by considering the scattering of ω and ψ isoscalars (D = 1285 and E = 1420) on pions were investigated, as were sum rules involving the scattering of vector and axial vector particles on K-mesons. The full amplitude representing the scattering of a vector or axial vector particle was decomposed on any given target into the invariant amplitude; and, from the postulated superconvergence, the sum rule for any isospin state in the s-channel was obtained. Implications on the sum rule on pions was considered, the sum rule for the coupling constants was obtained, and sum rules resulting from the scattering of vector and axial vector particles on K-mesons were evolved. M.W.R.

N68-35992# Joint Publications Research Service, Washington, D. C.
ONE THOUSAND GIGAELECTRONVOLT CYBERNETIC ACCELERATOR
A. L. Mints 18 Sep. 1968 14 p refs Transl. into ENGLISH from Priroda (Moscow), no. 4, 1968 p 8–15
(JPRS-46447) CFSTI: HC $3.00/MF $0.65

Basic principles of proton accelerators are discussed, emphasizing those of ring-type operation; and strong focusing and automatic parameter control of betatron oscillations are considered. Some experiences in building accelerators in the Soviet Union are noted; and the principles of constructing an accelerator, referred to as a cybernetic accelerator, are discussed. The increased power required by a 1000-gigaelectron volt cybernetic accelerator is noted, and mention is made of some less powerful accelerators in current use. M.W.R.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-34846 Case Inst. of Tech., Cleveland, Ohio.
PROPAGATION IN WAVEGUIDES FILLED WITH WARM PLASMA
Philip W. Nield (Ph.D. Thesis) 1967 183 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-16092

The linearized equations describing the propagation of the normal modes in a plasma filled waveguide at microwave frequencies and in the presence of an axial constant magnetic field are derived from moments of the Boltzmann equation. Collisions are retained. For two cases where the plasma is assumed to be drifting but uniform or stationary but non-uniform in the transverse plane it is possible to completely solve for the fields by solving a set of coupled equations for the axial electric and magnetic fields and the pressure. If the plasma is assumed to be stationary and uniform these reduce

to a set of coupled Helmholz equations. Solutions for this case are considered in detail. The equations can be simplified considerably and cast into a form very similar to those used to describe wave propagation in a cold plasma. Solutions are obtained by employing an iterative technique. Dissert. Abstr.

N68-34861 Arkansas Univ., Fayetteville.
POSITIVE ION HEATING OF PLASMAS PRODUCED FROM THE SOLID STATE
David Paul Ross (Ph.D. Thesis) 1967 193 p
Available from Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 67-12889

A technique for measuring the positive ion temperatures of plasmas produced *in vacua* has been developed in this laboratory. The technique, which involves the determination of the translational temperature through a velocity analysis of time of flight data, was applied to plasmas produced by the explosion of wires. Analyses indicated that the plasmas occasionally developed temperature in excess of a million degrees Kelvin. Such high temperatures are neither experimentally expected nor theoretically predicted. Experimental information, additional to the positive ion temperature measurements, are developed to show that under certain circumstances an exploding wire may produce a plasma which is primarily heated by adiabatic compression in a dynamic pinch rather than the usually assumed joule heating in a static pinch. Dissert. Abstr.

N68-34943 Minnesota Univ., Minneapolis.
CONDITIONS GOVERNING THE SYMPTOMATIC BEHAVIOR OF AN ELECTRIC ARC IN A SUPERIMPOSED FLOW FIELD
Steve Arthur Wutzke (Ph.D. Thesis) 1967 193 p
Available from Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 67-14667

The conditions governing the symptomatic behavior of a DC electric arc in a superimposed flow field are studied experimentally in an arc tunnel using a simplified electrode geometry. Special emphasis is placed on the parameter dependencies of the arc-flow-electrode interactions. Several aspects of the transition from the steady mode to the restrike mode of arc operation are examined in detail. The simplified electrode geometry consists of two plane, water-cooled, copper anodes situated opposite each other in the top and bottom of the test section. A tungsten cathode is positioned parallel to the anodes from the upstream end of the test section. The side of the test section is fitted with a quartz window which allows direct visualization of the entire arc and is used to observe the arc motion. Dissert. Abstr.

N68-34947 Cornell Univ., Ithaca, N. Y.
SUPER ALFVENIC ALIGNED FIELD AIRFOILS OR THE FLOW OF THE SOLAR WIND PAST AN ANGEL'S WING
Daniel William Yannitell (Ph.D. Thesis) 1967 105 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-16380

The major problem treated is that of hydromagnetic flow past a thin symmetric airfoil, impulsively set into motion along a uniform applied magnetic field at a speed greater than that of Alfvén waves. Before this problem is solved, however, a general discussion of the characteristics and boundary conditions in MHD flows is given. It is shown that large disturbances are created initially through the emission of Alfvén waves, and that these disturbances are confined to wave clusters whose thickness is small, of the same order as the airfoil thickness. Alfvên emission persists for a finite time only, after which these clusters are shed downstream, leaving essentially ordinary potential flow in the neighborhood of the airfoil. This is contrasted with sub-Alfvénic flow where the wave emission continues, the clusters remaining attached to the airfoil and ultimately forming slug regions fore and aft in which the fluid is brought to rest relative to the airfoil. Dissert. Abstr.

N68-34956 Ohio State Univ., Columbus.
MICROWAVE DIAGNOSIS OF INHOMOGENEOUS PLASMA BOUNDARY LAYERS
James Terrence Flynn (Ph.D. Thesis) 1967 79 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-16277

Diagnosis of an inhomogeneous plasma using a microwave device for measuring reflection and transmission coefficients is described. A method has been developed for theoretically evaluating the reflection and transmission coefficients for oblique incidence of plane, TE waves on inhomogeneous plasma profiles when asymptotic solutions of the wave equation are not available. A general model using Gaussian distributions is proposed and the model is matched to a shock tube plasma. Diagnosis of the plasma is accomplished by matching theoretical reflection and transmission coefficients to the measured data. Dissert. Abstr.

N68-34957 Purdue Univ., Lafayette, Ind.
THE RADIATION PRODUCED BY AN ARBITRARILY ORIENTED DIPOLE IN AN INFINITE, HOMOGENEOUS, WARM, ANISOTROPIC PLASMA
Robert William Graff (Ph.D. Thesis) 1967 221 p
Available from Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 67-16640

An expression for the electric field produced by an arbitrarily oriented electric dipole in a warm, anisotropic, single-fluid plasma is derived. The radiation patterns are found for the specific example of a dipole oriented perpendicularly to the externally impressed magnetic field, for a plasma in which $\omega_p = 0.412\ \omega$, $\omega_c = 0.75\ \omega$, $\omega = 3 \cdot 10^8$ radians per second, and $U = 0.003$ c. Results are found to be consistent with previous analyses, yet show significant changes produced by the consideration of electron temperature. Large maxima of radiation were found in the endfire direction, which are not found by the cold-plasma analysis. The procedure of analysis was to reduce the governing equations for this model to a single inhomogeneous wave equation in the electric field intensity, E, and to subsequently introduce a dyadic Green's function representation for E. The resulting homogeneous equation in the Green's function dyadic, G, was then Fourier-transformed, and the algebraic equations produced were then solved for G. Dissert. Abstr.

N68-35003 Case Inst. of Tech., Cleveland, Ohio.
WAVE INTERACTION IN NONRELATIVISTIC ELECTRON BEAM-PLASMA SYSTEMS
Gerald Anthony Otteni (Ph.D. Thesis) 1967 149 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-16093

A theoretical model based on the linearization of the fluid equations and Maxwell's equations for wave interaction in a uniform plasma which is interpenetrated by a nonrelativistic electron beam is developed. The effects of electron-neutral and electron-ion collisions and temperatures of both the beam and plasma electrons are included and no quasi-static approximation is made for the electromagnetic field. An external d.c. magnetic field is assumed to act so that a general formulation is developed which is valid in the limit of small d.c. magnetic fields and in the limit as the field becomes very large. Graphs of the computer solutions are given for the propagation constants in a beam-plasma system for the cases of an unbounded system and for the TM wave solutions that may exist in an axisymmetric cylindrical system in which the finite beam interpenetrates an unbounded plasma. Dissert. Abstr.

N68-35037 Stanford Univ., Calif.
THE FLOW OF RARIFIED PLASMA PAST A SPHERE
David Jehiel Prager (Ph.D. Thesis) 1967 129 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-11060

The problem of determining the macroscopic flow variables and the electric potential distribution about a sphere is formulated within the framework of the Vlasov equation. Steady-state conditions are assumed and magnetic effects neglected. Approximate solutions for the distribution functions of the electrons, ions, and neutral particles are obtained by exploiting the feature that the characteristics of Vlasov's equation are the particle trajectories in phase space, and the distribution function is constant along a characteristic. Approximate expressions are obtained for the potential, drag, energy transfer, and slip velocity as a function of the ion speed ratio and surface potential. Approximations for the ion and electron number densities in the flow field are determined which are valid for large ion and small electron speed ratios, respectively. Dissert. Abstr.

N68-35049 Michigan Univ., Ann Arbor.
SCATTERING BY A TORUS
Pushpamala Laurin (Ph.D. Thesis) 1967 93 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-15652

Solutions of low frequency scattering of acoustic and electromagnetic waves by a torus are derived using a quasi-static approach. The solutions are in power series, in ascending powers of k, the wave number. These series are also called the Rayleigh series and are valid for small k. Since the method is such that the solution is constructed from the solution of the potential equation, Laplace's equation is solved in toroidal coordinates for both the Dirichlet and Neumann boundary conditions. Green's function is derived for the Dirichlet case and particular problems are solved for the Neumann case. These results also have applications in fluid dynamics. Dissert. Abstr.

N68-35063 Polytechnic Inst. of Brooklyn, N. Y.
RADIATION AND SCATTERING PROBLEMS IN COMPRESSIBLE PLASMAS
Frank Michael Labianca (Ph.D. Thesis) 1967 184 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-13401

Ray-optical concepts are introduced for propagation of electromagnetic and electroacoustic waves in an unbounded compressible plasma, and are then applied to the analysis of radiation in the presence of plane or curved interfaces and obstacles. The method involves tracing of the electromagnetic and acoustic rays through the medium, taking account of coupling in source regions, at boundaries, and at scattering centers. The formulas for the reflected,refracted, and diffracted fields derived by the ray-optical procedures are verified by considering different two-dimensional geometries involving bounded, homogeneous, isotropic, compressible plasma regions and performing an asymptotic analysis of the exact integral representations developed for the electromagnetic and dynamical fields due to various excitations. The agreement between the results derived by the two methods lends substance to the validity of the ray-optical procedure for even more general configurations which are not readily subjected to rigorous analysis. Diffraction effects in the form of edge scattered fields, lateral waves on plane boundaries, and creeping waves on circular cylinders have also been studied. The field expressions were cast into ray-optical form. The amplitude dependence in the latter two types of effects can be derived only by exact analysis. In the case of the lateral waves the ray trajectory can be predicted through the use of refractive index diagrams. Dissert. Abstr.

N68-35076# Texas Univ., Austin. Electronics Research Center.
RELATIVISTICALLY INTERSTREAMING BOUNDED PLASMA INTERACTIONS
Gayle P. Martin and Robert K. Likuski 15 May 1968 142 p refs
(Grant AF-AFOSR-766-67)
(AFOSR-68-1083; TR-49; AD-672283)

The characteristic equation has been formulated and some of its solutions are presented in the form of dispersion diagrams for a circular cylindrical waveguide loaded with several concentric regions of plasma interstreaming at relativistic velocities along the guide axis; the axis is aligned with an externally applied dc magnetic field. The small signal approximation was used in the derivation of the characteristic equation, but the quasi-static approximation was not used, and relativistic terms were retained. The plasma components display no thermal effects except through a collision frequency representing collisions in which all of the particles ac momentum is lost. The dispersion diagrams presented, which were obtained through use of a CDC 6600 computer, represent a variety of electron beam interactions with an electron-ion plasma for modes with no angular variation; some stationary plasma data is also presented. The interactions of an electron beams fast and slow space charge and cyclotron modes with the first and second plasma cyclotron and space charge modes were calculated for a variety of combinations of beam density, radial size, and velocity. Author (TAB)

N68-35081# California Inst. of Tech. Pasadena. Antenna Lab.
ELECTRIC DIPOLE RADIATION IN ISOTROPIC AND UNIAXIAL PLASMAS
John J. Kenny May 1968 97 p refs
(Grant AF-AFOSR-1400-68)
(AFOSR-68-1081; TR-44; AD-672267)

An investigation is described of radiation from an electric point dipole situated in a cold, collisionless, homogeneous, electronic plasma medium. Two limiting cases of a gyroelectric medium are studied. The magnetostatic biasing field is first taken to be equal to zero, making the medium isotropic, and then it is taken to be infinite, causing a uniaxial anisotropy. The retarded electromagnetic fields and the instantaneous and averaged values of irreversibly radiated power are calculated. In each medium, the partial differential equations resulting from the two-sided Laplace transformation of Maxwells equations with an oscillating electric dipole source and the constitutive equations (derived from the appropriate form of the Lorentz force equation) are solved. Author (TAB)

N68-35082# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PULSED ARC IN ARGON AT PRESSURES UP TO 10 TO THE 8th POWER N/SQ M [IMPULSNAYA DUGA V ARGONE PRI DAVLENIYAKH DO 10 TO THE 8th POWER N/SQ M]
E. S. Borovik, V.P. Kantsedal, Yu. P. Knyazev, V. Mitin, and V. I. Petrenko 13 Oct. 1967 10 p refs Transl. into ENGLISH from the book "Vzaimodeistvie Zariazhennykh Chastits s Plazmoi" Kiev, Izd. Naukova Dumka, 1967 p 115–123
(FTD-HT-23-1378-67; AD-672335)

A description is given of an experimental setup producing argon pulsed arcs at pressures up to 10 to the 8th power newton/sq m with currents up to 50 ka, and a pulse duration on the order of .001 sec. Argon plasmas with densities on the order of 10 to the 20th power/cc and temperatures on the order of 40,000K are obtained on the setup. Considerable emission absorption is established in such plasmas. Author (TAB)

N68-35097# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Plasmadynamik.

APPROXIMATIVE METHODS OF THE CALCULATIONS OF SEVERAL PLASMA-PARAMETERS AND THE SPECIAL APPLICATION ON PLASMA-FLOWS. PART 3: APPROXIMATIVE CALCULATIONS OF SHOCK WAVE PARAMETERS OF PLASMAS IN LTE [NAEHERUNGSMETHODEN ZUR BESTIMMUNG ZAHLREICHER PLASMAPARAMETER UND DEREN SPEZIELLE ANWENDUNG AUF PLASMASTROEMUNGEN. TEIL 3: NAEHERUNGSBERECHNUNGEN VON STOSSWELLENPARAMETERN THERMISCHER PLASMEN]

Joachim Artmann Jul. 1968 40 p refs In GERMAN; ENGLISH summary

(DLR-FB-68-37, Pt. 3: DVL-743, Pt. 3) CFSTI: HC $3.00/MF $0.65

Approximative solutions are presented which are derived from the extended Rankine-Hugoniot theory of reacting LTE plasmas. The approximative solutions do not only simplify the calculations very much, but also the physical picture becomes clearer. Simple equations can be derived for the density ratio in the region of the dissociation and of the following ionization-stages. The density-ratio shows typical maxima which are caused by the change of the specific heat. The quantities can be presented immediately for vanishing reactions. The density-ratio assumes the well-known value 4 for very high temperatures. The pressure behind the shock is proportional to the square of the shock-velocity in the whole temperature range, whereas the temperature in the region of the reactions increases with the strength of the shock a little weaker. The calculation is performed for hydrogen, helium, nitrogen and argon for initial pressures 0.1 and 1 torr. Finally the most important plasma parameters are calculated behind the reflected shock waves in nitrogen. Author

N68-35112# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Plasmadynamik.

APPROXIMATIVE METHODS OF THE CALCULATIONS OF SEVERAL PLASMA-PARAMETERS AND THE SPECIAL APPLICATION ON PLASMA-FLOWS. PART 2: APPROXIMATIVE CALCULATIONS OF EXPANSIONS OF PLASMAS IN LAVAL-NOZZLES [NAEHERUNGSMETHODEN ZUR BESTIMMUNG ZAHLREICHER PLASMAPARAMETER UND DEREN SPEZIELLE ANWENDUNG AUF PLASMASTROEMUNGEN. TEIL 2: NAEHERUNGSBERECHNUNGEN ZUR ENTSPANNUNG VON PLASMEN IN LAVAL-DUESEN]

Joachim Artmann Jul. 1968 34 p refs In GERMAN; ENGLISH summary

(DLR-FB-68-36; Pt. 2; DVL-742, Pt. 2) CFSTI: HC $3.00/MF $0.65

The conservation-laws can be applied for flowing plasmas in an easy way by means of the approximative method described in detail in part I, if graviational and electromagnetic forces, friction, heat-conductivity and radiation is neglected. Especialily the calculation of some special cases of the expansion in Laval-nozzles can be achieved very simply. The degree of dissociation or ionization (x or x_1 [part I]) is introduced for the special case of frozen flow (x or x_1 = const); because the adiabatic equation of ideal gases can be used here. Also the calculation can be performed very easily for the other case of LTE. The heating of the flowing plasma (with constant temperature during expansion) can be included in these two cases. These investigations are very important for describing flows in plasma propulsion-systems. Four special cases are performed here for hydrogen-, lithium- and argon-plasmas. Author

N68-35113# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Plasmadynamik.

APPROXIMATIVE METHODS OF THE CALCULATIONS OF SEVERAL PLASMA-PARAMETERS AND THE SPECIAL APPLICATION ON PLASMA-FLOWS. PART 1: APPROXIMATIVE CALCULATIONS OF THERMODYNAMIC FUNCTIONS OF LTE PLASMAS [NAEHERUNGSMETHODEN ZUR BESTIMMUNG ZAHLREICHER PLASMAPARAMETER UND DEREN SPEZIELLE ANWENDUNG AUF PLASMASTROEMUNGEN. TEIL 1: NAEHERUNGSBERECHNUNGEN VON THERMODYNAMISCHEN FUNKTIONEN THERMISCHER PLASMEN]

Joachim Artmann Jun. 1968 82 p refs In GERMAN; ENGLISH summary

(DLR-FB-68-35, Pt. 1; DVL-741, Pt. 1) CFSTI: HC $3.00/MF $0.65

It is shown generally and especially e.g. for hydrogen, helium, nitrogen, oxygen and argon that the thermodynamic functions can be calculated by simple approximative methods in the regions of the dissociation of two-atomic molecules and of succeeding ionization-stages. In the region of the dissociation e.g. the partition-function of the oscillation is approximated by $kT/h\nu$. This is generally valid in the temperature range $T \geq \lambda$ (λ Wave Number [cm^{-1}]). The description of the different ionization-stages can be simplified very much, if the regions of overlapping reactions are very small. A criterium for this approximation is obtained that this reaction is decisive for succeeding reactions for which the ionization degree is $x_1 \geq 0.01$. These approximative methods do not only enable a very quick and simple evaluation—the inaccuracy is below <10%—but also the expression of the formulas become very simple so that a physical interpretation of these is very easy. . . . Author

N68-35170 Purdue Univ., Lafayette, Ind.

HARMONIC GENERATION USING THE VARACTOR CAPABILITIES OF THE PLASMA SHEATH

Robert Thomas Hilbish (Ph.D. Thesis) 1967 145 p

Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-16649

A study is made of large signal, high frequency phenomena occurring in a slightly ionized plasma contained within a set of concentric, metallic coaxial cylinders. The frequency is constrained to lie between the ion and electron plasma frequencies. From a time independent numerical solution of the Tonks and Langmuir "complete plasma-sheath equation," sheath, pre-sheath, and plasma regions are defined based upon the relative electron and ion density profiles between the coaxial cylinders. From a quasi-static analysis, an rf equivalent circuit is developed wherein the sheath is represented by a voltage dependent capacitor in parallel with voltage dependent resistor and the pre-sheath by a "collisionless" loss element. From a separate small signal analysis it is shown that the plasma region can be represented by a series resistor and inductor. The validity of the equivalent circuit is experimentally verified by comparing current waveforms as predicted by the equivalent circuit and as obtained experimentally with an rf voltage driving a mercury vapor discharge plasma contained within the required coaxial geometry. As an application of the plasma varactor, frequency doubling using standard semiconductor varactor techniques is attempted. Dissert. Abstr.

N68-35171*# Ohio State Univ., Columbus.

INPUT ADMITTANCE AND REFLECTION COEFFICIENT OF A CIRCULAR APERTURE IN A GROUND PLANE COVERED BY A HOMOGENEOUS DIELECTRIC OR PLASMA SLAB

R. E. van Doeren Washington NASA Sep. 1968 33 p refs (Grant NGR-36-008-048)

(NASA-CR-1177) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The reflection coefficient and admittance of a circular aperture in a ground plane radiating into a dielectric slab medium lying directly on the ground plane is considered. The work relies heavily

on previous efforts by Compton and Rudduck. Calculations are performed for lossless dielectric and lossy plasma slabs. The admittance for lossless slabs is compared with the experimental data of others. Author

N68-35222# Institute for Defense Analyses, Arlington, Va. Jason Div.

MULTIPLE SCATTERING OF ELECTROMAGNETIC WAVES IN AN UNDERDENSE PLASMA

Kenneth M. Watson Jun. 1968 70 p refs

(Contract DAHC15-67-C-0011)

(IDA/HQ-68-8936; RP-P-428; AD-673224)

Scattering of electromagnetic waves by an extended underdense plasma is studied. The analysis begins with expressions for multiple scattering of waves. An explicit account of coherent scatterings leads to modified equations. These modified equations are used to derive a transport equation for the intensity (a tensor expressed in polarization components). It is shown that this transport equation may be applied to the calculation of radar backscatter. Author (TAB)

N68-35227 Northwestern Univ., Evanston, Ill.

EXPERIMENTAL MEASUREMENT OF THE EMISSION AND ABSORPTION OF RADIATION BY AN ARGON PLASMA

Donovan Lee Evans (Ph.D. Thesis) 1967 184 p

Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-15228

A thermistor bolometer is used to obtain spatially resolved measurements of the volumetric radiative losses or total radiation of an argon plasma in the spectral range of 0.2 total radiation of an argon plasma in the spectral range of 0.2 to 3.5 microns. The measurements were correlated with temperature at pressures of 0.5, 1.0 and 2.0 atmospheres. The use of a free burning arc as a source allowed measurements at temperatures from 10,000° to 26,000°K by spectroscopy and the Fowler–Milne technique. For the one atmosphere case, total radiation measurements were also made in the spectral range of 0.2 to 22 microns. Comparison between the two spectral ranges showed little difference below 13,000°K, with more energy appearing in the longer wavelengths as the temperature increased above this value. Absorption measurements on both the total radiation and line radiation have also been made so that emission results could be corrected for absorption. Corrections for the undetected ultraviolet radiation were made. The 6965.43 Al line has been studied in detail. Line shifts, 1/2-halfwidths, absorption coefficients and emission coefficients have been measured. Transition probabilities from both emission and absorption studies are found to agree. Dissert. Abstr.

N68-35268# Innsbruck Univ., (Australia). Inst. for Theoretical Physics.

SIMILARITY SOLUTIONS FOR TWO-DIMENSIONAL STEADY VISCOUS MGD BOUNDARY LAYERS

Ferdinand Cap and Dietmar Floriani May 1968 21 p refs

(Contract F61052-67-C-0014)

(SR-56; AFOSR-68-1326; AD-672996)

The purpose of the report is to solve the equations for steady two-dimensional MGD-flows (i) in boundary layer approximation, (ii) without approximation. A magnetic field B perpendicular to the flow plane and constant but arbitrary viscosity, electrical and heat conductivity are assumed. First, all equations are written in a form free of parameters and then similarity transformations are applied. Via the transformed continuity equation, the new equations can be simplified for channel flows. If this similarity solutions enclose incompressible flows, the solution for the velocity is, for boundary layer approximation, given in a closed form. Author (TAB)

N68-35269# Innsbruck Univ., (Australia). Inst. for Theoretical Physics.

HALL EFFECT, ION SLIP AND END EFFECT IN FARADAY GENERATORS

Helmut Bresgen and Helmut Falser Mar. 1968 30 p refs

(Contract F61052-67-C-0014)

(SR-55; AFOSR-68-1307; AD-672995)

The investigation of a Faraday type generator is carried out under the assumption of low electrical conductivity. Therefore, the fluid and Maxwell equations can be decoupled, neglecting interaction between plasma and applied magnetic field. This leads to Laplacian equations for the stream and potential functions, which are solved by the method of Fourier series expansion, subject to mixed boundary conditions. The resultant infinite set of equations for the Fourier coefficients can be solved numerically to desired accuracy. Hall effect and ion slip are included. The first part starts from only one pair of electrodes and thus yields end effects resulting from a lengthening of the current lines in the plasma. In part two and three, generalizations for variable velocity profile, several pairs of electrodes and also variable electrical conductivity are pointed out. In the last chapters the method is compared to other approaches and a numerical calculation of the internal resistance for several values of Hall parameter and aspect ratio of the generator duct is carried out. Author (TAB)

N68-35319# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF ENERGY SPECTRA OF A CONICAL ELECTRODE SOURCE OF PLASMA [ISSLEDOVANIYE ENERGETICHESKIKH SPEKTROV KONICHESKOGO ELEKTRODNOGO ISTOCHNIKA PLAZMY]

A. A. Kalmykov, V. I. Tereshin, and N. S. Poltavtsev 6 Oct. 1967 13 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Ukr. SSR, Fiz.-Tekhn. Inst. (Ukrania), no. 4, 1965 p 285–293

(FTD-MT-24-263-67; AD-672705)

An analysis of the plasmoids formed in a conical source was carried out with a time-of-flight mass spectrometer. The microstructure of the plasmoids and the distribution of ions of different masses with respect to energy were studied in small areas of the clots. The mechanism for the acceleration of the particles is different for energies < or = 150 ev. and > or = 500 ev. In the latter case (the formation of fast protons) the formation of the fast particles may take place in the spark. Author (TAB)

N68-35321*# Scripta Technica, Inc., Washington, D. C.

TOROIDAL STELLARATOR TYPE MAGNETIC TRAP WITH EXTERNAL PLASMA INJECTION [TOROIDAL'NAYA MAGNITNAYA LOVUSHKA STELLARATORNOGO TIPA S VNESHNEY INZHEKTSIYEY PLAZMY]

M. S. Berezhetskiy, S. Ye. Grebenshchikov, N. M. Zverev, and S. Shpigel' NASA Sep. 1968 10 p refs Transl. into ENGLISH from Fiz. Plazmy (Moscow), 1966 p 20–28

(Contract NASw-1694)

(NASA-TT-F-11630) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A toroidal stellarator magnetic trap with a double-coil magnetic field is described. It is different from other magnetic traps in that it facilitates the comparison between experimental and theoretical results. The magnetic field of this trap is made time variable to permit a study of adiabatic plasma heating, in addition to standard plasma behavior studies. The correctness of the theoretical basis of this trap design is confirmed by experimental results for its magnetic field structure and method of plasma injection. The existence of magnetic surfaces and the effective capture of a currentless plasma by a helical field are proved. Author

N68-35358*# Franklin GNO Corp., West Palm Beach, Fla.
HIGH TEMPERATURE STUDY OF ELECTROPHILIC GASES FOR PLASMA QUENCHING
W. D. Kilpatrick 18 Jan. 1968 55 p refs
(Contract NAS1-6884)
(NASA-CR-66568) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Electron attachment studies were carried out for eight different electrophilic materials through the use of high temperature techniques up to 2000°C. The materials were all liquids with approximate vapor pressure of $0.01 < P < 250$ torr at room temperature, except for SF_6 which was used for reference and calibrations. Not all of the materials were amenable to measurement at 2000°C due to chemical decomposition. The materials examined were C_6F_{14} (perfluorohexane) C_7F_{16} (perfluoroheptane), C_8F_{18} (perfluoroctane), $(C_4F_9)_3$ N (perfluoroamine, also FC-43), Freon E-3, Freon E-5, Freon E-9, and argon which was used as an inert carrier. Three methods were employed for the various measurements over the temperature range from room temperature to 2000°C: (a) Drift cell for mobility and attachment measurements at room temperature, (b) Static low-pressure oven for breakdown up to 1000°C and (c) Molecular beam for breakdown of mixtures up to 2000°C. Comparison of the data from the three methods shows that Freon E-9 is highly electrophilic, and retains its electrophilic property under thermal equilibrium to 2000°C. Author

N68-35383# Aerospace Corp., El Segundo, Calif. Lab. Operations.
EFFICIENCY ESTIMATES FOR CONVERSION OF FOCUSED LASER RADIATION TO X-RAYS IN A HOT DENSE PLASMA
Melvin J. Bernstein and Gerald G. Comisar Mar. 1968 20 p refs
(Contract F04695-67-C-0158)
(TR-0158(3220-50)-4; SAMSO-TR-68-212; AD-672964)

The report examines the feasibility of using focused laser radiation to generate a dense high-temperature plasma in the keV range that will reradiate a significant amount of the absorbed energy as high energy photons. The difficulty is that the plasma expands more rapidly as the temperature is increased, thereby diminishing the plasma radiation rate, which depends on the free electron density. The total radiation will be on the order of two to three times that of bremsstrahlung alone and will consist primarily of photon energies that are less than an energy corresponding to the plasma temperature. For a temperature of several keV, the plasma will expand within a few tenths of a nanosecond, requiring that the lasers have equally short pulses for optimum use of the laser energy. The frequencies of Nd-glass lasers and ruby lasers correspond to maximum electron densities of about 1 to 2 X (10 to the 21st power)/(cu cm), and estimates place the emitted x radiation at around 1 to 2% of the energy absorbed in a fraction of a nanosecond. Use of frequency-doubling crystals or creation of high-power ultraviolet lasers would increase the efficiency by up to an order of magnitude. Author (TAB)

N68-35392# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THREE-PHASE ALTERNATING CURRENT PLASMATRONS [TREKHFAZNYE PLAZMATRONY PEREMENNOGO TOKA]
F. G. Rutberg, A. A. Kiselev, and V. A. Dolyuk 20 Oct. 1967 13 p Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Tekhn. Nauk (Tashkent), no. 3, 1966 p 98-103
(FTD-MT-24-235-67; AD-672697)

The author presents two designs of three-phase alternating current plasmatrons intended for obtaining low temperature plasmas. The design of these plasmatrons differs by the number of electrodes (three and six), cooling system arrangement, and dimensions. Both types were tested using argon, nitrogen, hydrogen, and helium gases at pressures between 1.5 and 15 atm. The plasmatrons were operated continuously for no more than 15 min due to limiting gas supply. The minimum currents at which they operated stably were 30 and 80 amp for 3-electrode and 6-electrode versions, respectively. The electrodes were made of tungsten 8-10 mm in diameter. Maximum test current and current density was 520 amp and 660 amp/sq cm, respectively. The plasmatrons were cooled by water and their temperatures did not rise above 40-50C. Author (TAB)

N68-35430# Texas Univ., Austin. Electronics Research Center.
SPACE-TIME RESOLVED MACH-ZEHNDER INTERFEROMETER MEASUREMENTS OF CROSS-SECTIONAL ELECTRON DISTRIBUTION IN THETA-PINCH PLASMA
Howard N. Roberts and Arwin A. Dougal 22 Apr. 1968 138 p refs
(Grant AF-AFOSR-766-67)
(AFOSR-68-0878; TR-47; AD-672813)

In theta-pinch deuterium plasmas instabilities are studied extensively and related to end losses, axial density minima, and neutron production. Non-rotating flute and flute-like instabilities form in the first quarter-cycle in all reverse biased plasmas. Mode numbers and evolution characteristics are highly dependent on reverse bias strength. Kink instabilities rotating near 1 rev/micro sec always develop near or after the time of peak-B for -2.7 to -4.0 kG and in certain cases for -1.3 kG bias. For 0.04 to 0.10 Torr a Mach-Zehnder interferometer illuminated by a 175 MW (6943 A) giant pulse ruby laser and axially coupled to the plasma yields space-time resolved cross-sectional electron distributions. A digital computer technique employs information extracted from the interference fringe patterns to determine the total number of electrons present. Plasma luminosity viewed axially through a Kerr cell shutter is deduced to be highly representative of electron distributions. He-Ne laser coupled resonator data agree to within + or - 30 percent to the interferometer data. Numerical predictions of a modified Hain-Roberts digital computer code agree with the experimentally deduced trends. Author (TAB)

N68-35442# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PARAMETERS OF MAGNETOHYDRODYNAMIC (MHD)-GENERATORS TAKING INTO ACCOUNT IONIZATION INSTABILITY OF PLASMA [PARAMETRY MGD-GENERATOROV S UCHETOM IONIZATSIONNOY NEUSTOYCHIVOSTI PLAZMY]
V. A. Gurashvili, Yu. Kareyev, and A. V. Nadospasov 6 Oct. 1967 28 p refs Transl. into ENGLISH from IAE-1348 Rept.
(FTD-MT-24-205-67; AD-672686)

A discussion is given of calculations of MHD generators with unbalanced conductivity taking into account ionization instability. As a working medium argon and mercury vapor containing addition of cesium vapors are examined. Theory and experiment show that ionization instability is developed with such parameters of plasma which are assumed to be used in MHD generators with unbalanced conductivity. New approaches toward the selection of MHD generators are touched upon. Author (TAB)

N68-35505# United Kingdom Atomic Energy Authority, Culham (England).
MICROWAVE PROBE INVESTIGATION OF PLASMA TURBULENCE IN A HIGH CURRENT TOROIDAL DISCHARGE
M. M. Larionov and V. V. Rozhdestvenskii [1967] 12 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), no. 38, 1968 p 279-284
(NP-TR-1676; CTO-498) CFSTI: HC $3.00/MF $0.65

Various effects arising from the interaction of microwave radiation with a turbulent plasma were investigated in Alpha (a high-current toroidal discharge stabilized by a weak longitudinal magnetic field and conducting wall). Fluctuations in the amplitude of the probe signal after passing through a layer of turbulent plasma were investigated. NSA

N68-35533# Nagoya Univ. (Japan). Inst. of Plasma Physics.
STUDIES OF ELECTRON CYCLOTRON PLASMA IN A MIRROR TRAP
Hiroyuki Ikezi. May 1968 25 p refs
(IPPJ-67) CFSTI: HC$3.00/MF$0.65

Hot electron plasma is produced in a magnetic mirror field by high power microwave discharge (5 kW at 6.4 GHz). The electrons are heated to over 100 keV and microwave interferometer measurements give electron densities greater than 10^{12}/cc. The hot electrons are observed to be bunched in a shell structure with a radius of 10 cm. Because of the structure, the plasma exhibits paramagnetism on the axis of the machine. The plasma life time is measured by turning off the microwave power. For pressures greater than 10^{-4} Torr, the plasma is stable and decays with a time constant of about several tenths of a millisecond. During the stable decay, instabilities can be artificially triggered by irradiation of a pulsed microwave (≈100 W) at the same frequency as the heating microwaves. The instabilities are characterized by a sudden disappearance of plasmas and are accompanied by a burst of energetic electrons escaping from the trap in radial and axial directions, a fast rising X-ray signal, a sudden increase of light intensity, and an intense burst of microwave radiation. Interference detection reveals that the radiation is circularly polarized and composed of transverse waves. Author

N68-35568# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Energiewandlung und Elektrische Antriebe.
MEASUREMENT OF THE ELECTRIC CONDUCTIVITY AS FUNCTION OF TIME AND SPACE ON AN INDUCTIVE PLASMA SOURCE [MESSUNG DER ELEKTRISCHEN LEITFAEHIGKEIT ALS FUNKTION DER ZEIT UND DES ORTES BEI EINEM INDUKTIV ERZEUGTEN PLASMA]
R. Koehne Aug. 1968 41 p refs In GERMAN; ENGLISH summary
(DVL-761; DLR-FB-68-47) CFSTI: HC$3.00/MF$0.65

Time- and space-resolved spectroscopic measurements of particle density, temperature, and electrical conductivity were carried out on an inductive, transient helium plasma source of an acceleration system with electromagnetic standing waves. The distribution of electron and ion density indicates that the He plasma had an annular structure. This structure remained constant along a range of 14 cm, corresponding to a time of 4.4 μsec of the accelerated plasma pulse. The electron temperature and conductivity also remained constant. The maximum electron density near the plasma surface was $1.6 \cdot 10^{16}/cm^3$, in the center it was $7.5 \cdot 10^{15}/cm^3$. The temperature was 57,000°K and 23,000°K, respectively, and the conductivity was 20,000/(Ωm) and 10,000/(Ωm) respectively. K.W.

N68-35569# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Plasmadynamik.
APPROXIMATE METHODS OF THE CALCULATIONS OF SEVERAL PLASMA-PARAMETERS AND THE SPECIAL APPLICATION ON PLASMA-FLOWS. PART 4: APPROXIMATE CALCULATIONS OF TRANSPORT-COEFFICIENTS OF PLASMAS IN LTE [NAEHERUNGSMETHODEN ZUR BESTIMMUNG ZAHLREICHER PLASMAPARAMETER UND DEREN PEZIELLE ANWENDUNG AUF PLASMASTROEMUNGEN. TEIL 4: NAEHERUNGSBERECHNUNGEN VON TRANSPORT KOEFFIZIENTEN THERMISCHER PLASMEN]
J. Artmann Jul. 1968 58 p refs In GERMAN; ENGLISH summary
(DVL-744; DLR-FB-68-38) CFSTI: HC$3.00/MF$0.65

Approximate solutions which simplify the calculation of viscosity, thermal conductivity, and electrical conductivity are developed. The method yields simple formulas for the thermal conductivity of reactions in the range of the dissociation and the subsequent ionization stages. A comparison with the exact results of the transport coefficients shows for hydrogen, nitrogen, and argon, temperatures up to 10^5°K, and pressures between 10^{-3} and 10 atm that the average error rate of the approximation is lower than 10%. K.W.

N68-35584# Sandia Corp., Albuquerque, N. Mex.
ON THE FORM OF INELASTIC TRANSPORT CROSS SECTIONS FOR PLASMAS
R. L. Fox Apr. 1968 12 p ref
(Contract AT(29-1)-789)
(SC-RR-68-171) CFSTI: HC$3.00/MF$0.65

Expressions for the cross sections required to calculate transport properties are derived from the collision term of the Boltzmann equation. The inelastic diffusion cross sections are calculated for electron excitation of the first excited states of hydrogen. Comparisons between the inelastic diffusion cross sections and the cross sections obtained using a $(1-\cos\theta)$ wieghting factor show order of magnitude differences at certain energies. Author (NSA)

N68-35619# Nagoya Univ., (Japan). Inst. of Plasma Physics.
A NEGATIVE "V" SYSTEM WITH THE DEEP WELL DEPTH OF 80 %
Kazunari Ikuta May 1968 7 p refs
(IPPJ-69) CFSTI: HC$3.00/MF$0.65

The fat $l=1$ torus that has a well deeper than 80% is proposed for the confinement of high temperature plasma, and the existence of the magnetic surface is related to the toroidal curvature. The configuration of conductors carrying current for a negative "V" system is illustrated, as are some numerically computed magnetic surfaces. M.W.R.

N68-35638# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Strahlantriebe.
THE BEHAVIOUR OF A BLOWN ARC BETWEEN COAXIAL CYLINDERS IN A TRANSVERSE MAGNETIC FIELD [DAS VERHALTEN EINES ANGESTROEMTEN LICHTBOGENS ZWISCHEN KOAXIALEN ZYLINDERN IM TRANSVERSALEN MAGNETFELD]
Rudolf F. Neubauer 4 Jun. 1968 28 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-40) CFSTI: HC$3.00/MF$0.65

Experiments describing the behavior of an arc between coaxial watercooled copper electrodes are reported. The air flow is directed against the arc which burns under atmospheric pressure in an external transverse magnetic field. If the inner electrode is used as an anode the arc burns in the gap. This may be caused by a plasma jet coming from the inner electrode and going to the outer electrode. Changing the polarity, this plasma jet is not efficient enough to stabilize the arc which becomes longer. A Lorentz force, resulting from an azimuthal current density and a radial magnetic field component, is directed against the gas flow and able to stop the growing of the arc length. Author

N68-35643# Nagoya Univ. (Japan). Institute of Plasma Physics.
PROBE NOISE IN QUIESCENT PLASMAS
Hiroyuki Ikezi, Masami Fujiwara, and Kazuo Takayama Jun. 1968 40 p refs
(IPPJ-71)

The observing frequency f normalized to the electron plasma frequency f_{pe} is between 10^{-3} and 1. In the low frequency range, $f/f_{pe} << 1$, the probe noise consists of the shot noise for the electron collecting region of the Langmuir probe, even when the probe potential is higher than the space potential. The shot noise arising from the probe electron current suffers a reduction due to the transit time effect near the electron plasma frequency. In

this frequency range the thermal noise is observed instead of the shot noise. Resonant increases of the noise current are found at the sheath-plasma resonance and at the plasma wave resonance frequencies. On the other hand the noise current arising from the probe ion current is smaller than the full shot noise level. The reduction factor for the noise is found to depend on f/f_{pi}, where f_{pi} is the ion plasma frequency. A mechanism for the reduction of the ion shot noise is proposed. Author

N68-35663# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF SUPERSONIC RADIAL NOZZLES FOR MHD-GENERATORS [ISSLEDOVANIYE SVERKHZVUKOVYKH RADIAL'NYKH SOPEL DLYA MGD-GENERATOROV]
B. A. Tikhonov and V. R. Shevchenko 14 Oct. 1967 19 p ref Transl. into ENGLISH from Russian Rept. IAE-1347
(FTD-MT-24-208-67; IAE-1347; AD-672687)

Article discusses the results of the investigation of gas dynamics of radial (fan) supersonic nozzles. Experimental data are given on the influence of basic geometric dimensions of the radial nozzle on its gas-dynamic characteristics. Recommendations are given on the designing of shock-free radial nozzles with uniform field of speeds on the outlet. TAB

N68-35701# Nagoya Univ. (Japan). Inst. of Plasma Physics.
INTERACTION BETWEEN PLASMA FLOW AND A MAGNETIC BARRIER: SHOCK FORMATION
C. Leloup and R. T. Taussing Jun. 1968 50 p refs
(Grant NSF GF-245)
(IPPJ-72) CFSTI: HC $3.00/MF $0.65

A time dependent plasma flow compatible with most of the experiments involving a plasma gun working in a high density regime is considered. Shock development is due mainly to evolution of the flow parameters. Only sub-Alfven flow velocities are allowed so that only a gasdynamic shock can develop. Calculation around the sonic transition in the barrier shows that except for a very fast increase of density, the distribution of pressure can produce backward facing sound waves in the flow. The pressure gradient is strong and the sound waves converge quickly close to the sonic point. If the ion–ion collision time is smaller than the converging time, then no Landau damping occurs and a shock can develop. If the ion–ion collision time is larger than this converging time, assuming collision free trajectories for ion, the pressure gradient becomes weak and no clear shock is expected. The optimum condition for shock formation has a simple formulation and is given. Author

N68-35775# Technische Hochschule Stuttgart (West Germany). Inst. fuer Plasmaforschung.
STUDY OF TORSIONAL ALFVEN WAVES IN INHOMOGENEOUS PLASMAS
P. G. Schueller, G. Mueller, W. Aldinger, E. Raeuchle, and H. J. Kaeppeler Aug. 1967 17 p refs Presented at the 2nd European Conf. on Controlled Fusion and Plasma Phys., Stockholm, 14–18 Aug. 1967
(Rept.-3-13; CONF-670840-1)

The propagation of torsional Alfvén waves in a current-carrying inhomogeneous hydrogen plasma was investigated. The plasma is generated by a longitudinal discharge in a glass tube. The maximum current is 4.2 kA. The tube is designed as a waveguide. The initial gas pressure is approximately 0.1 mm Hg. A quasi-stationary longitudinal magnetic field up to 5 kG is applied. The Alfvén waves were excited by a short current pulse over a secondary electrode ($m = 0$ mode), or a single loop coil ($m = \pm 1$ mode) and were detected by magnetic probes. The probe signals were Fourier-analyzed to obtain the dispersion relation. By this method, the dispersion curve was measured in a frequency range from 100 kc up to 1 Mc. The measured phase velocities are in the range of 10^7 cm/sec and the damping constant is about 10^{-1} cm. The inhomogeneity of the plasma density leads to nonuniform phase velocity and damping over the cross section of the plasma column.

N68-35776# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Plasmaphysik.
BREMSSTRAHLUNG OF A FULLY IONIZED PLASMA IN THE INFRARED
P. Bogen and D. Rusbueldt [1967] 9 p refs Presented at Pulse High-Density Plasmas Conf., Los Alamos, N. Mex. Supported by EURATOM
(CONF-670928-5)

The frequency dependence of the bremsstrahlung for $h\nu << kT$ and $\nu > 2\nu_p$ (where ν_p is the plasma frequency) was measured and compared with theory. Experiments were carried out on a theta pinch with the following data: $\tau/4 = 0.75$ μsec, $B_{max} = 45$ kG, $T \approx 10^6$°K, $N_e \approx 3 \times 10^{17}$ cm^{-3}. The intensity between 0.25 μ and 25 μ has been measured with a time resolution of 20 nsec, using an InAs photodiode and a copper-doped germanium photoresistive detector in the infrared, and a photomultiplier in the visible and ultraviolet domains. It was verified that the emission signals observed side-on were at all times and for all wavelengths practically proportional to one another; shape differences observed end-on resulted almost certainly from refractive index effects. The experiments confirm the theoretical prediction, that the Gaunt factor should vary by a factor two in the investigated wavelength domain. No influence of three-body encounters or nonthermal radiation has been detected. Author (NSA)

N68-35781# Technische Hogeschool, Eindhoven (Netherlands). Electrical Engineering Dept.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF A NON-EQUILIBRIUM PLASMA IN A MHD CHANNEL
A. Veefkind, J. H. Blom, and L. H. Th. Rietjens Mar. 1968 21 p refs Presented at the Symp. on Magnetohydrodyn. Elec. Power Generation, Warsaw, 24–30 Jul. 1968
(TH-68-E-02) CFSTI: HC $3.00/MF $0.65

Continuity, momentum, energy, and Poisson equations are given for describing the behavior of a magnetohydrodynamic (MHD) working fluid; and electron temperature elevation caused by Joule heating of a nonequilibrium plasma in an MHD channel is discussed. Numerical solutions for the basic equations were obtained by computer for a non-seeded argon working medium; and the disk generator apparatus for an experimental study of electron temperature elevation and nonequilibrium ionization in such a medium is described. An inductive plasma gun is used to heat and accelerate the medium in order to keep the impurity level as low as possible. The parameters in the produced plasma pulses are approximately constant over a length of about 0.2 m, the plasma cloud velocity is ≥ 800 m/sec, the total density is about 10^{22}m^{-3}, and the electron temperatures are between 2000 to 5000°K. The plasma parameters are strongly dependent on the voltage of the capacitor bank, the time delay between the opening of the valve and the moment of discharge, and the moment of clamping. M.W.R.

N68-35798# Nagoya Univ. (Japan). Inst. of Plasma Physics.
PRESSURE DEPENDENCE OF A PLASMA DIFFUSION ACROSS A UNIFORM MAGNETIC FIELD
Johahin Uramoto May 1968 23 p refs
(IPPJ-70) CFSTI: HC $3.00/MF $0.65

By controlling only a neutral gas pressure, diffusion modes of a plasma across a uniform magnetic field B are varied independently of boundary wall conductivity. That is, the diffusion up to $B = 10^3$G is of a classical ambipolar diffusion near a helium gas pressure of

10^{-1}mmHg, of a Bohm type diffusion near 10^{-2}mmHg, and of a classical ion free diffusion near 10^{-3}mmHg. The plasma is produced by continuous injection from a modified duoplasmatron, whose length is 34cm along B. With a decrease of the pressure, random noise potentials in the plasma increase up to the electron temperature. Thus, the electron diffusion, in the plasma near 10^{-3}mmHg where Simon effect may be observed, is enhanced greatly compared with the classical diffusion. As a result, the ambipolar field is much reduced so that the effect is not ensured. Author

N68-35816# Heidelberg Univ. (West Germany).
THE MEASUREMENT OF ELECTRIC FIELDS IN A PLASMA APPLYING THE FIELD MILL PRINCIPLE [DIE MESSUNG ELEKTRISCHER FELDER IM PLASMA NACH DEM INFLUENZPRINZIP]
K. Knott Jun. 1968 19 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Wiss. Forsch.
(BMwF-FB-W-68-45) CFSTI: HC$3.00/MF$0.65

The possibility of measuring electric fields in an ionized medium applying the surface charge induction method is investigated. First the field between the negatively charged body and the positive space charge layer enveloping the body is calculated. Then the influence of a field in the undisturbed plasma on the field at the surface of the body is estimated. It turns out that it is possible under certain conditions to measure ionospheric electric fields by applying a sensitive cylindrical field mill in a rocket experiment. Author

N68-35820# Miami Univ., Coral Gables, Fla. Dept. of Physics.
VARIATIONAL APPROACH TO THE DYNAMIC STABILITY OF HIGH-DENSITY PLASMAS IN MAGNETIC CONTAINMENT DEVICES
Daniel R. Wells and Joseph Norwood, Jr. 1 Jun. 1968 53 p refs Revised
(MIAPH-PL-68.3) CFSTI: HC$3.00/MF$0.65

Variational methods are used to determine the structure of dynamically stable plasmoids. The total energy of the plasmoid is varied subject to a set of constraint integrals on the flow. It is demonstrated that the resulting flow structure results in a plasmoid of the type observed experimentally when the angular momentum of the plasmoid is not conserved. This is the collinear vortex structure. New experimental results are presented which demonstrate that the structures observed in mirror trapping experiments may be of the type predicted by the variational calculation. Author (NSA)

N68-35893# Princeton Univ., N. J. Plasma Physics Lab.
STUDY OF PLASMA COMPRESSION BY MEANS OF REFLECTION OF SUPERHIGH-FREQUENCY WAVES
V. A. Ipatov, M. G. Kaganskii, S. G. Kalmykov, and V. A. Ovsyannikov Jun. 1968 20 p refs Transl. into ENGLISH from a Russian report
(Contract AT(30-1)-1238)
(MATT-TRANS-59) CFSTI: HC$3.00/MF$0.65

It is demonstrated that it is possible to investigate the compression of a plasma by an external magnetic field, using superhigh frequency radiation range and detection equipment. The measurements were taken on wavelengths of 4 mm and 8 mm. It is demonstrated that a sharp decrease in the concentration of the plasma takes place near the diaphragm in the Tuman device. The radius of the plasma column inside of which the concentration exceeds 1.7×10^{13} cm^{-3} decreases to 3 cm during compression (the radius of the diaphragm is 6 cm). The rates of displacement of the plasma layers with critical concentrations exceed the rates calculated from the condition of freezing the magnetic field in the plasma by 2 to 3 times. Author (NSA)

N68-35901# Sandia Corp., Albuquerque, N. Mex. Library Scientific Translation Service.
DESCRIPTION OF TWO NEW PROBES FOR ENTHALPY AND PRESSURE MEASUREMENTS IN HIGH TEMPERATURE GASES [SONDEN ZUR MESSUNG von ENTHALPIE UND DRUCK HOCHERHITZTER GASE]
W. Fischer-Schlemm 20 May 1968 47 p refs Transl. into ENGLISH of Deut. Luft- und Raumfahrt Res. Rept. DLR-FB-67-17
(SC-T-68-1524; DLR-FB-67-17) CFSTI: HC$3.00/MF$0.65

A new enthalpy probe and a new enthalpy and pressure probe for measurements in high-temperature gases (4,000 to 15,000°K) are described. A jet, emerging from a plasma generator, was measured with these probes. Mass and energy ratings were made. Additionally the results were compared with the results obtained from an enthalpy and pressure probe which is known since 1962. Author (NSA)

N68-35919# California Univ., Livermore. Lawrence Radiation Lab.
COMPUTATIONAL PROBLEMS IN PLASMA PHYSICS AND CONTROLLED THERMONUCLEAR RESEARCH
John Killeen 8 Jul. 1968 96 p
(Contract W-7405-eng-48)
(UCRL-71205) CFSTI: HC$3.00/MF$0.65

Numerical calculational methods for plasma physics are described for each of the following: pinch experiments, resistive instabilities, finite-β equilibria, Fokker–Planck equation, and the Vlasov equation. NSA

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-34816 Rochester Univ., N. Y.
PHOTOELECTRIC EMISSION FROM THIN FILM RARE GAS SOLIDS IN THE VACUUM ULTRAVIOLET AT 20°K
John Francis O'Brian (Ph.D. Thesis) 1967 117 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-13638

Measurement of the intrinsic photoelectric yield has been made for thin films of the rare gases at 20°K in the vacuum ultraviolet region above 10.5 nm. Structure is observed in the quantum yield curves which can be associated with exciton and interband transitions. No photoelectric threshold is observed below the LiF cutoff at 11.8 eV for argon and krypton films, but a threshold which is observed for xenon films near 9.7 eV. For all the rare gases emission is observed below the direct photoelectric threshold which is similar to that observed for colored alkali halide samples. No emission structure is observed in Ar:Xe films at the position of the trapped exciton lines. Using an optical band gap of 9.28 eV, the electron affinity of xenon is estimated from the photoelectric threshold to be 0.39 ± .03 eV and the work function is 5.03 ± .03 eV. The absorption spectrum of xenon is discussed and the strong 10.3 eV line is attributed to a 5d-like exciton transition at the point Γ'_5 in k-space. Dissert. Abstr.

N68-34847 IIT Research Inst., Chicago, Ill.
THE THEORY OF TRAPPED ELECTRON-PHONON INTERACTION IN REALISTIC CRYSTALS

John Thomas Ritter (Ph.D. Thesis) 1967 214 p
Available from Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 67-12854

A new electron-phonon interaction scalar potential is developed from two points of view: (1) applying Maxwell's equations to a microscopic model of a lattice of actual ions; and (2) reformulating the Fröhlich theory by taking into account the actual details of the lattice vibrations. This electron-phonon interaction potential is applied to the problem of vibronic spectra fine structure from electron traps. A "per mode Huang-Rhys factor" or "Sj" is obtained. Sj is the product of two quantities: one depends on the details of the lattice vibrations and the other is related to the details of the electron trap geometries. Calculations using available perfect lattice vibration data were carried out for LiF, KCl and NaCl crystals and were compared to R_2, R' and M' center spectra in these crystals. There is good agreement between experiment and theory. The interpretation of this agreement is that the electron-phonon interaction potential accurately describes the trapped electron-ionic crystal system. Much better agreement between theory and experiment is obtained from calculations based on polarizable ion model vibration data than on rigid ion model vibration data. Dissert. Abstr.

N68-34860 Delaware Univ., Newark.
ANALYSIS OF EXPERIMENTS IN SINGLE CRYSTAL X-RAY DIFFRACTOMETRY
Robert Elliot Zumwalt (Ph.D. Thesis) 1966 126 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Odrer No. 67-11753

Summary data are given on work devoted to an analysis of some of the basic problems in single crystal X-ray diffraction techniques. A mathematical model for the General Electric single crystal orienter is derived. This is an original derivation which should be useful to the experienced crystallographer, as well as to the novice experimentalist. Equations and a chart allow the angular settings on the instrument to be determined, so that certain operations may be performed on the crystal. A useful compendium of the current technology in the areas of instrumental alignment, crystal orienting and cutting , and crystal monochromatization of the diffracted beam is included. An analysis of rocking curves obtained with the diffracted-beam monochromator is given with emphasis on the rocking curves of mosaic crystals. The effect of vertical divergence is explored in considerable detail. An effort is made to show what experimental conditions are required for the quantitative interpretation of rocking curve data. Dissert. Abstr.

N68-34864 Utah Univ., Salt Lake City.
THE RELEASE OF STORED ENERGY IN MAGNESIUM DURING RECOVERY AND RECRYSTALLIZATION
Donald Howard Nielson (Ph.D. Thesis) 1967 115 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-12299

The energy stored in magnesium during cold work and released during annealing was measured by differential calorimetric methods. The amount of energy stored was found to be dependent on the severity of the deformation and the specific impurity addition. This stored energy came from dislocation annihilation and dislocations annihilating vacancies. The activation energy, however, indicated a similar mechanism of dislocation movement for all types of samples. During annealing it was found that all the energy was measured for recovery processes and none for recrystallization processes. This energy was measured as the area under a ΔT vs. T curve. The fractional element of energy was compared to the reciprocal temperature by a type of rate expression producing a straight line. The activation enthalpies were obtained from the slope of this line. This activation enthalpy was found to be 2 to 5 kilocalories. Dissert. Abstr.

N68-34868 Ohio State Univ., Columbus.
INVESTIGATION OF INTERVALLEY SCATTERING EFFECT IN THE ELASTOCONDUCTANCE OF N-TYPE SILICON AND GERMANIUM
Chung Kyu Kim (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-16295

The final expression of elastoconductance contributed by intervalley scattering is in the form of an integral with the relaxation time, $\tau(\Delta\epsilon)$, in it and the relaxation time depends on the electron transition probability, which is in turn related to the electron scattering by lattice vibrations, impurities, etc. Since the magnitude of transition probability for each scattering mode is not known, the proposed relaxation time model had unknown constants (RM, RD, and RU) representing the amplitudes of transition probabilities for each scattering mode. For the determination of those unknown constants, the relaxation time was substituted into the expression of elastoconductance contributed by intervalley scattering and this was plotted as a function of temperature for each different set of values of constants with the aid of a computer. This temperature dependence was then compared with that of experiment to obtain the approximate values of (RD) and (RM). Dissert. Abstr.

N68-34892 Northwestern Univ., Evanston, Ill.
SOFT X-RAY DIFFRACTION BY MULTILAYERED THIN FILM STRUCTURES AND THEIR INTERDIFFUSION
John Bullard Dinklage (Ph.D. Thesis) 1967 55 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-15222

Five orders of soft x-ray diffraction by multilayered thin film structures of Fe and Mg have been obeerved. The structures consisted of as many as 200 layers of Fe seperated by Mg layers, providing layer spacings of 30–50 Å. The diffracting characteristics have been measured for the wavelength range 8.34 to 23.7 Å (Al K_α to O K_α). The integrated diffracted intensities from Fe-Mg layered structures and multilayered lead sterate soap film structures are shown to be comparable. A diffracted x-ray peak intensity to background ratio of 80 and a resolution ($\lambda/\Delta\lambda$) of 25 have been observed for the diffraction of O K_α radiation by the Fe-Mg structures. No diffusion in the Fe-Mg layers was detected at room temperature. The diffracted x-ray intensity from the Fe-Mg layered structures decreased to one-half (half life) in 5.7 hours at 156°C because of interdiffusion. Dissert. Abstr.

N68-34904 California Univ., Berkeley.
THE DETECTION AND ANALYSIS OF MODULATED FERROMAGNETIC STRUCTURES BY TRANSMISSION ELECTRON MICROSCOPY AND DIFFRACTION
Robert Emerick Villagrana (Ph.D. Thesis) 1967 55 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-11673

The unique determination of the wave functions characterizing alloys which undergo spinodal decomposition has presented a major problem to investigators utilizing conventional techniques. By wave functions one means the composition fluctuations with distance along a specific crystallographic direction. A method is proposed, based on the Lorentz deflection of an electron in a magnetic field, by which composition fluctuations in ferromagnetic spinodal alloys (e.g., one phase is ferromagnetic while the other phase is virtually non-magnetic) can be detected. Experimentally this analysis is accomplished using transmission electron microscopy and diffraction. In order to logically develop this theory of analysis, a phenomenological picture of diffraction from alloys exhibiting square wave and sine wave composition fluctuations was presented. The two-beam dynamical theory of electron diffraction was then applied in order to obtain a more exact solution to the problem. Dissert. Abstr.

N68-34939 Northwestern Univ., Evanston, Ill.
PHONON RESONANCES IN SOME ALKALI HALIDES DOPED WITH DIVALENT IONS
John William Schwartz (Ph.D. Thesis) 1967 110 p
Available from Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-15334

The thermal conductivity of KCl doped with Ca++, Sr++, Ba++ and Eu++; KBr doped with Ba++ and Sr++ and NaCl doped with Ca++ and Sr++ has been measured between 1.2°K and 100°K. In each of the thermal-conductivity-versus-temperature curves for the doped crystals a localized dip in the thermal conductivity was observed in the region of 25° to 50°K. The dip was explained in terms of a resonant scattering of phonons by quasi-localized modes. Two different scattering mechanisms were used in analyzing the data. Mass defect only scattering was found to be unsuccessful in explaining the data. Scattering of phonons by force constant changes at the defect was found to explain the data with reasonable values for the change in force constants. It has been postulated that the associated vacancy which accompanies the divalent impurity ion is a primary scatter of phonons. In the three cases in which the divalent ion is the same size as the host ion it replaces it is felt that the vacancy is the dominant scatterer of phonons. For the cases in which the divalent ion size differs from the host the scattering of phonons is effected in a minor but complicated way. For the complex cases the data will be completely understood only when a detailed treatment of the dynamics of the divalent ion-vacancy couples is done. Dissert. Abstr.

N68-34944 American Univ., Washington, D. C.
THE LOW TEMPERATURE ELECTRONIC PROPERTIES OF SINGLE CRYSTAL, EPITAXIALLY GROWN GALLIUM PHOSPHIDE DOPED WITH ZINC
Marvin Morris Cohen (Ph.D. Thesis) 1967 119 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-12365

Van der Pauw measurements were made to determine the resistivity, carrier concentration, percentage of compensation and mobility of epitaxially grown, P-type gallium phosphide. The measurements were carried out in the temperature range 4.2°K to room temperature. The data of compensation analysis indicate that the gallium phosphide is very highly compensated by N-type imputities (as high as 97% in one sample). Surface studies made by the etch technique of revealing dislocation edges show a dislocation density of 2.3×10^4 cm^{-2}. Large growth rings and growth spirals indicate that the epitaxial growth was uneven in the (111) direction. The activation energy of the zinc hole in the gallium phosphide lattice was investigated as a function of impurity concentration and compared with the data of other researchers which was obtained optically and by the Hall method. In the impurity band conduction range the mobility was too low to be experimentally determined. Dissert. Abstr.

N68-34964 Cornell Univ., Ithaca, N. Y.
ANNEALING KINETICS OF VACANCY DEFECTS IN QUENCHED GOLD AT ELEVATED TEMPERATURES
Chia-Gee Wang (Ph.D. Thesis) 1967 78 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-13930

A new technique was developed to study the annealing of excess vacancy defects in quenched gold in the temperature range of 200°C to 870°C. The 0.005" dia gold wire specimen was subjected to either a straight downquench, or to a partial quench, an intermediate isothermal anneal, and a further downquench to a final temperature where the defects were frozen in. The fraction of defects annealed during these treatments was obtained by measuring differences in the residual electrical resistivity at 4°K. The temperature-time history was digitized and recorded in a half cycle computer memory, which could resolve temperature fluctuations to better than 0.1°C. Data analysed by the minimization of relative errors indicated that a vacancy defect α, found over a wide range of conditions, has a migration energy of 0.69 ± 0.01 eV. Considering the defect α to be a divacancy, its binding energy is 0.5 ± 0.1 eV. The data are consistent with tracer self-diffusion data from 700°C to 1050°C and the defect diffusion coefficient measured previously by Siegel at 40°C when the migration and formation energies of the monovacancy have the values 0.90 ± 0.02 eV and 0.94 ± 0.02 eV respectively. Dissert. Abstr.

N68-34965 Cornell Univ., Ithaca, N. Y.
INFRARED ABSORPTION OF SUBSTITUTIONAL IMPURITIES IN ALKALI HALIDES
Richard Chu-tak Tseng (Ph.D. Thesis) 1967 102 p
Available from Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-16373

A theoretical calculation of the effect of substitutional impurities on the infrared lattice absorption of alkali-halide crystals is discussed within the framework of a Kubo-type formulation of the dielectric susceptibility with the use of double-time Green's functions. Using the deformation dipole model for the perfect crystal and the experimental data from optical absorption, an increase of 14% of nearest-neighbor force constant is found in NaI:Tl system. Dissert. Abstr.

N68-35001 Case Inst. of Tech., Cleveland, Ohio.
CYCLOTRON RESONANCE IN MAGNESIUM
Dale A. Zych (Ph.D. Thesis) 1967 117 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-16113

Azbel'–Kaner cyclotron resonance has been investigated in magnesium at 22.9 Gc/sec and 2°K. The observed resonances have been assigned to thirteen different orbits on the Fermi surface. Although the one-OPW model of Harrison was found suitable for the identification of the orbit responsible for a given mass series, the measured cyclotron masses are greater by factors which range from 1.02 to 1.52 than those calculated from the one-OPW model. This difference is attributed to the combined influence of band structure, the electron-phonon interaction, and many-body effects. One mass series is associated with an orbit resulting from magnetic breakdown between the second and third bands. No signals were observed that could be assigned to either the "giant orbit" or the network of orbits that accompany it. Dissert. Abstr.

N68-35008 Rice Univ., Houston, Tex.
STUDIES OF THE AC LOSSES AND OF THE MAGNETIZATION OF SUPERCONDUCTING WIRES
Henry Fuller Taylor, III (Ph.D. Thesis) 1967 94 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-13130

AC-induced voltages and energy losses observed for superconducting wires are compared with predictions based on Bean's model. Magnetization data for wires subject to an axially applied magnetic field are compared with magnetization curves predicted by Bean's model. Observations of anomalous energy loss and magnetization behavior for the case of ac flowing in an applied axial field are explained on the basis of a semi-force-free model. Dissert. Abstr.

N68-35007 City Univ. of New York.
A THEORETICAL INVESTIGATION OF SUBSTITUTIONAL Li+ IN KCl
William Dennis Wilson (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 67-9473

The minimum energy configurations of the ions surrounding a substitutional Li+ impurity in KCl are determined using a point

ion model. The position of minimum energy for the Li^+ itself was found to be off the lattice site in the (111) direction. The potential which a Li^+ ion sees in its translational tunneling between neighboring minima is given as a symmetrical sixth power polynomial. The tunneling splitting and dipole moment are found to be in reasonable agreement with experiment. The Born-Mayer-Verwey potential is tried and rejected because of its unreasonalbe hardness and a potential appropriate to the experimental data is developed. Uniform hydrostratic pressure effects are estimated and the possibility of other small impurity ions being off-center is discussed. The case of Li^+ in KBr is also considered. Dissert. Abstr.

N68-35013 State Univ. of New York at Buffalo.
FIELD ENHANCEMENT IN SUPERCONDUCTING TUBES
Eugene Frederick Young (Ph.D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-13370

The magnetic behavior of tubes made of superconducting material has been studied as they pass through the superconducting transition. This investigation has been an attempt to discover why the field in the hole of the tube becomes larger than the applied field. It has been found that the amount of field enhancement f (f is defined as the ratio of the final to the initial magnetic field in the hole of the tube) is dependent on a number of factors. These factors are: geometry of the specimen, specimen preparation and machining, cooling rate through the superconducting transition, and applied field. A number of different materials were studied: tin, mercury, indium, and a tin–indium alloy. The geometrical factors investigated were the effects on f of changing the ratio of the outside to inside diameter (O.D./I.D.), the length to diameter ratio, and the shape of the ends. In an attempt to understand the behavior of f as a function of the outside and inside diameters, several models have been presented. These give expressions for f in terms of the inside and outside diameter. These models are compared with the experimental data. Dissert. Abstr.

N68-35017 Polytechnic Inst. of Brooklyn, N. Y.
SPECIAL TOPICS IN THE THEORY OF SPACE CHARGE LIMITED CURRENTS
Ronald Barry Schilling (Ph.D. Thesis) 1967 150 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-13419

Various topics in the theory of space-charge-limited-currents (SCLC) are investigated herein to study some of the unexplored areas associated with this important subject. A summary of the major contributions in steady state and transient space charge limited current problems is presented. Emphasis is placed on transient SCLC. The possible existence of oscillations in transient SCLC was suggested by scientists in this field. It is demonstrated herein, by the formulation of a modal equation, that a discrete set of oscillatory modes does exist. The conditions under which diffusion can be neglected for both the steady state and transient situations are studied. The validity of neglecting diffusion in SCLC will be demonstrated by finding the diffusion current and compering it to the drift current. The diffusion current is then studied as a perturbation term in the total current equation. We next consider SCLC in a system composed of more than one structure e.g., a semiconductor-dielectric (oxide) structure, or a dielectric–dielectric structure. Dissert. Abstr.

N68-35074 Princeton Univ., N. J.
PULSE HEIGHT AND TRANSIENT RESPONSE OF SEMICONDUCTOR RADIATION DETECTORS TO FISSION FRAGMENTS
Alan Henley Krulisch (Ph.D. Thesis) 1967 146 p
Available from Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-13498

The pulse height response of silicon surface barrier detectors was measured as a function of energy for median light and heavy fission fragments of Cf^{252} over an energy range of $100 \geq E \geq 7$ MeV. The results demonstrated that the calibration procedure proposed by Schmitt, for undegraded fission fragments is actually valid over an energy range of $100 \geq E \geq 25$ MeV. Comparison of the pulse height respone to fission fragments with the response to alpha particles yielded the pulse height defect as a function of energy. The magnitude and shape of the curve were found to be in disagreement with a calculation by Haines and Whitehead based on the unified range theory of Lindhard and co-workers. The transient response of silicon surface barrier detectors was measured as a function of the energy of incident Cf^{252} fission fragments. Dissert. Abstr.

N68-35078# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
MULTIPARTICLE TUNNELLING
J. W. Wilkins Jul. 1968 46 p refs
(Contract Nonr-401(38))
(TR-24; AD-672349)

The article reviews the properties of single-particle excitations in a superconductor with a view to providing a qualitative description of the one- and two-particle tunnelling processes. One-particle processes, including the Josephson effect, are of first order in the square of the tunnelling matrix element while two-particle processes are of second order. Details of the calculation (which has not previously been published) of the two-particle tunnelling current are presented. Comparison with experiment reveals the inadequacy of the theory. Finally, the report returns to the first-order process, in particular to the a.c. Josephson effect which may prove to be the source of the multi-particle-like structure in the tunnelling data. TAB

N68-35154# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Physics.
PRESSURE DEPENDENCE OF THE ELASTIC CONSTANTS OF SINGLE CRYSTALS Final Report
Charles S. Smith Aug. 1968 9 p refs
(Contract Nonr-1141(05))
(AD-673265)

A summary is given of a research program involving the investigation of the pressure variation of the elastic constants of single crystals. The materials examined included Cu, Ag, Au, Al, Mg, Cd, Li, Na, K, Rb, NaCl, KCl. An investigation was also undertaken on the ultrasonic equation of state of Fe. A list of technical reports and publications resulting from the work is included. TAB

N68-35167 Purdue Univ., Lafayette, Ind.
RADIATION DAMAGE STUDIES IN DEGENERATE Si IRRADIATED AT LOW TEMPERATURES
Louis Lajos Sivo (Ph.D. Thesis) 1967 170 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 67-16711

Pulled (Czochralski) and float-zone n-type (NC, NF) and p-type (PC, PF) degenerate Si samples were irradiated using 1 MeV electrons and studied by DC conductivity, δ, and Hall coefficient R_H measurements. The experiments clearly demonstrated the temperature, the charge state and the Fermi level dependence of the irradiation effects. Dissert. Abstr.

N68-35178*# National Bureau of Standards, Boulder, Colo. Inst. for Basic Standards.
SUPERCONDUCTION THIN FILMS
R. A. Kamper, L. O. Mullen, and D. B. Sullivan Washington NASA Sep. 1968 38 p refs
(NASA Order C-7756-B)
(NASA-CR-1189; NBS-9708) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Attention is concentrated mainly on the properties and applications of the Josephson effect at radio frequencies. The characteristics of the emitted radiation under various conditions were explored; a simple theory was constructed of the linewidth (which was verified); new principles were conceived for an absolute milli-degree thermometer and a picovoltmeter; a prototype of the picovoltmeter was built and tested; and a reliable method for fabricating good tunnel junctions between thin films of niobium and lead was developed. Author

N68-35188 Northwestern Univ., Evanston, Ill.
PRODUCTION AND STAGE 1 RECOVERY OF ELECTRICAL RESISTIVITY IN ELECTRON IRRADIATED NOBLE METALS
Frederick William Wiffen (Ph.D. Thesis) 1967 128 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-15367

The production of irradiation damage by incident 2.0 MeV electrons near liquid helium temperature and the subsequent damage recovery on annealing to 70°K have been studied in aluminum, copper, silver and gold. Specimens were formed from high purity (5–9's) wire 5.1 $\times$ 10^{-3} cm in diameter. The irradiated length was approximately 70 cm. Recovery was studied by isochronal annealing with points 0.5°K apart and with a holding time of 20 minutes at each temperature. The production and recovery of damage was followed by measuring changes in the resistivity of the specimens, all measurements being made at liquid helium temperatures. A very important result of the present work has been the demonstration in copper and silver of a dependence of the amount of stage I recovery on the initial damage concentration. Stage I recovery has been explained in a one-interstitial model similar in some aspects to the Corbett model. All recovery up to and including I_D is assigned to the annihilation by recombination of close Frenkel pairs (small interstitial-vacancy separation). Dissert. Abstr.

N68-35251# South Dakota School of Mines and Technology, Rapid City. Dept. of Physics.
THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY MEASUREMENTS OF EuO ACROSS THE CURIE TEMPERATURE IN A MAGNETIC FIELD
Mark L. Konantz (M.S. Thesis) 1 Jul. 1968 65 p refs
(Contract Nonr-2964(01))
(TR-24; AD-672773)

The thermal conductivity K of a hot-pressed sample of EuO (90% EuO, 10% Eu_2O_3) was measured in the temperature range 60-300K using the linear absolute method. K falls off sharply as the temperature goes below 90K, and then rises again by 60K. The dip is not symmetric but its sides intersect at 69K. K was also measured in a longitudinal magnetic field of 100 gauss in the temperature range 60-78K. A dip at 69K was again observed; however, in the magnetic field K fell off less sharply and the dip was much shallower. The electrical resistivity r was also measured. In the absence of the magnetic field r deviated by less than 1% from a value of 0.040 ohm-cm over the entire temperature range 60-300K. Application of the magnetic field resulted in changes of r of less than 2% throughout this same temperature range. The downward dip in the thermal conductivity at the ferromagnetic-paramagnetic transition temperature of 69K can be qualitatively understood in terms of critical scattering of phonons by critical fluctuation in the energy density of the spin system. Author (TAB)

N68-35300# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISTRIBUTION OF IMPURITIES IN CRYSTALS AS A FUNCTION OF CONDITIONS OF THEIR GROWTH [RASPREDELENIYE PRIMESEY V KRISTALLAKH V ZAVISIMOSTI OT USLOVIY IKH ROSTA]
M. G. Kekua 7 Dec. 1967 13 p refs Transl. into ENGLISH from Tr. Akad. Nauk Gruz. SSR, Inst. Met. (Tiflis), no. 14, 1964 p 171–178
(FTD-MT-24-341-67; AD-672711)

Studies aimed at determining the degree of inhomogeneity in the distribution of a doping impurity with a distribution coefficient in excess of unity were carried out on Ge single crystals doped with Si and grown in three ways: stationary method by slow cooling, pulling by Czochralskis method, and pulling from a melt supplied with a solid ingot. In specimens grown by the stationary method of slow cooling at a cooling rate of 1.5 deg/hr, the ingots were found to be inhomogeneous along the length and cross section. A homogeneous ingot structure was obtained by using the method of supplying the melt. Author (TAB)

N68-35355# Radio Corp. of America, Princeton, N. J.
MICROWAVE CONDUCTIVITY OF SUPERCONDUCTING THIN FILMS Final Report, 1 Jun. 1967–31 May 1968
Robert V. D'Aiello 31 May 1968 24 p refs
(Contract N00014-66-C-0311)
(AD-673101)

Microwave transmission as a function of temperature through thin superconducting films of pure tin and granular aluminum is reported. The experiments were conducted at 20 GHz, and covered the temperature range 4.2 degrees K to 1.8 degrees K. By a suitable analysis, the magnitude and temperature dependence of the complex conductivity of the film are obtained from the transmission data and related to the impedance of the films. The relative impedance levels for the tin and aluminum films are discussed with relation to use in parametric amplifier circuits. Methods of film preparation for the tin and granular aluminum are presented. Author (TAB)

N68-35356*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ULTRASONIC ATTENUATION IN SUPERCONDUCTING TANTALUM
Zoltan W. Sarafi Washington Sep. 1968 23 p refs
(NASA-TN-D-2806) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Ultrasonic attenuation was measured in single crystals of tantalum at frequencies from 30 to 330 MHz. The crystals were oriented in the (100) and (110) directions. The attenuations of longitudinal and transverse waves were measured as a function of temperature and magnetic field. Curves are presented showing the transition between the normal and superconducting states. The zero-temperature energy gaps obtained were 3.3 kT_c for both directions. The samples had q/ values intermediate between those used by other investigators, and a comparison of results indicated that the energy gap in tantalum is lower for samples with larger electronic mean-free paths. Author

N68-35364# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 4, NUMBER 6, 1968 Monthly Review
Jun. 1968 62 p refs
(AD-672814)

Contents: Paper: New type compounds of the rare-earth metal--gallium or indium--chalcogen system. Survey: Organization of ionospheric research in the USSR: 1958 to 1968. Notes: Problems of information theory; Chemical degradation of polypyromellitimides; Universal sensory receptor modeling; VIf radiotelemetry in the rock strata of the Earths crust; A new theory of ball lightning; The MG-SZ marine gravimeter; Automatic shipborne gravimeter; Some possible causes for the absence of canals in Mariner-4 photographs of Mars. Conference: Symposium on vitreous chalcogenide semiconductors. Personality: A. B. Nalbandyan. TAB

N68-35438# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

KERR MAGNETO-OPTIC STUDIES OF THE DOMAIN PATTERNS IN NICKEL IRON TAPES

F. J. Friedlaender, L. F. Silva, and Tom Bonnema Jun. 1968 116 p refs

(Contract N00014-67-A-0226)

(TR-EE68-15; AD-672556)

The models presently used to predict the low field, slow speed flux reversal phenonena in grain oriented 50% nickel 50% iron tapes have been confirmed indirectly from the voltage induced in a winding on a core. Domain observations using the Kerr magneto-optic effect have been made on the surfaces of the 50% Ni–Fe tape samples. The surface domain patterns differ depending on the sample preparation, which is described in detail. When the tape samples were annealed after electrochemical polishing the patterns observed were in close agreement with previously postulated models for flux reversal in the 50% Ni–Fe tapes. Data on the domain wall motion coercive forces is presented. A stress gradient between the top and bottom surfaces appeared after electrochemical polishing. The resulting domain patterns were complex. The correlation between the net magnetization of the sample and the surface domain patterns under stress was poor. The Kerr magneto-optic domain patterns on the surface of the tape sample could be used as a very sensitive indication of the presence of a stress on the surface. Author (TAB)

N68-35459# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Physics.

THE ANTIFERROMAGNETISM OF $Cs_2MnCl_4.2H_2O$

T. Smith and S. A. Friedberg 25 Jul. 1968 25 p refs

(Contract Nonr-760(26))

(TR-11; AD-672810)

Single crystal magnetic susceptibilities of triclinic Cs2MnCl4.2H2O were measured between 0.35 and 20K. Over this interval the susceptibility exhibits a uniaxial anisotropy about a direction parallel to the O-Mn-O axis of each octahedral complex (MnCl4.2H2O)(2-). Quantitative estimates of the magnetic dipolar anisotropy indicate it to be an order of magnitude too small to account for the observations above the Neel temperature. TAB

N68-35539# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Servizio Documentazione.

PRELIMINARY STUDY OF THE FERMI SURFACES OF BISMUTH BY MEANS OF THE DE HASS–VAN ALPHEN EFFECT [STUDIO PRELIMINARE DELLA SUPERFICIE DI FERMI DEL BISMUTO MEDIANTE L'EFFETTO DE HAAS–VAN ALPHEN]

E. P. Balsamo, F. Lucari (Centro Studi Nucl., Casaccia, It.), N. Sacchetti, and G. Sanna 3 Jul. 1968 42 p refs In ITALIAN

(LNF-68/41) CFSTI: HC $3.00/MF $0.65

Although the Fermi surfaces (FS) of bismuth were the first to be studied by the DeHaas–Van Alphen effect, it is shown that many questions concerning the energy spectrum remain unresolved. To answer some of these questions, this work accurately determines the electron structure of some FS, the study of FS cavities, and the measurement of the forces of the mass spin of charged particles. Transl. by F.O.S.

N68-35601*# Santa Clara Univ., Calif.

AN INVESTIGATION OF THE USE OF FARADAY ROTATION FOR THE MEASUREMENT OF MAGNETIC FIELDS

Raymond B. Yarbrough and Frank S. Greene, Jr. Apr. 1968 38 p refs

(NASA Order A-7237A)

(NASA-CR-73259) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The most promising materials for magneto-optic measurement of magnetic fields are thin films of iron, nickel, and cobalt. The investigation indicates little difference between the potential use of the Faraday and longitudinal Kerr effect; the choice should be made on the basis of experimental results. The galium arsenide junction lasers appear to provide inexpensive and compact light sources which should be adequate for the proposed system for measurement. Commercially available photodiodes and phototransistors are useful detectors. A method of cross-field excitation of thin films in conjunction with the optical apparatus provides a theoretically sensitive field detection scheme. The system is expected to be operable in the normal range of temperatures around 300°K, with deterministic variation of performance based on the temperature characteristics of the light source, light detector and the magnetic film. Author

N68-35639* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EIGENVALUES OF THE SPIN HAMILTONIAN FOR Fe^{3+} IN TiO_2

W. E. Hughes, C. C. Johnson, and L. E. Rouzer Aug. 1968 1148 p refs

(NASA-TM-X-63359; X-523-68-309) CFSTI: $3.00 CSCL 20L

Tabulated eigenvalues are presented, and the expression for the dynamic spin Hamiltonian is given. It is pointed out that there are two sites for the impurity ion in the host crystals, and the coordinate systems for the sites are indicated. N.E.N.

N68-35726*# Aztec School of Languages, Inc., Acton, Mass.

THE ELECTRICAL CONDUCTIVITY OF COPPER OXIDE [ZUR ELEKTRISCHEN LEITFAEHIGKEIR VON RUPFER-OXYDUL]

V. P. Zhuze and B. V. Kurchatov Washington NASA Oct. 1968 11 p refs Transl. into ENGLISH from Physik. Z. Sowietunion (Kharkov), v. 2, 1932 p 453–467

(Contract NASw-1692)

(NASA-TT-F-11919) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The temperature dependency of electrical conductivity of copper oxide plates with different oxygen contents will be investigated. The electrical conductivity of pure copper oxide at 12° is 2.7 · 10^{-10} ohm^{-1} cm^{-1}. The dissociation energy of the electrons in Cu_2O amounts to 0.72 volts. The electrical conductivity of copper oxide increases rapidly with the oxygen content; the latter is not larger than 0.1% of the weight. The dissociation work of electrons in well-conducted tests of copper oxide varies from 0.134 to 0.129 volts. Author

N68-35787*# Hiram Coll., Ohio. X-ray Physics Lab.

DEFECT PRODUCTION IN SINGLE CRYSTALS RESULTING FROM ION BOMBARDMENT Semiannual Status Report, 1 Jan.–30 Jun. 1968

Lawrence B. Shaffer 9 Aug. 1968 25 p refs

(Grant NGR-36-019-001)

(NASA-CR-97070; SASR-4) CFSTI: HC $3.00/MF $0.65 CSCL 20B

Damage produced on the surface of metal single crystals during ion bombardment using X-ray methods were studied, and certain thermodynamic properties of cesium gas were determined using X-ray methods. An ultrahigh vacuum system and ion gun apparatus are described. Cesium gas scattering investigations presented difficulties in cell design and adequately filling the tubes. Design and modification, detection electronics, and the high voltage power supply were considered for the double crystal X-ray spectrometer, for which the experimental procedure, computer analysis of data, and X-ray topographs are reviewed. M.W.R.

N68-35794# Pittsburgh Univ., Pa. Dept. of Chemistry.
THERMAL STRUCTURAL, AND MAGNETIC STUDIES OF METALS AND INTERMETALLIC COMPOUNDS Annual Report, 15 May 1967–15 May 1968
W. E. Wallace and R. S. Craig 15 May 1968 163 p refs
(Contract AT(30-1)-3454)
(NYO-3454-22) CFSTI: HC $3.00/MF $0.65

Work in progress is described briefly. Results of completed work on the following are summarized: magnetic and structural characteristics of the pseudobinary systems $TiFe_2$–YFe_2, $ZrFe_2$–YFe_2, and $TiFe_2$–$TiCo_2$; electronic specific heats of alloys of the $TiFe_2$–$ZrFe_2$ and $ZrCo_2$–$ZrFe_2$ systems; and magnetic and crystallographic characteristics of ternary intermetallic compounds of the form $Ln_{1-x}Ln'_xNi_2$. Copies of eight papers accepted for publication in various journals are included. NSA

N68-35866# International Business Machines Corp., Hopewell Junction, N. Y. Eastfishkill Lab.
MATHEMATICAL SIMULATION OF THE EFFECTS OF IONIZING RADIATION ON SEMICONDUCTORS
David P. Kennedy Apr. 1968 161 p refs
(Contract F19628-67-C-0116)
(AFCRL-68-0246; SR-1; AD-673367)

The report outlines the results of four mathematical investigations initiated during the present contract period: the high-low semiconductor junction, the junction field-effect transistor, the measurement of impurity atom distributions by differential capacitance techniques, and the electrical properties of a diffused semiconductor resistor. Two of these investigations remain incomplete; therefore, the information presented here constitutes a status report for these projects. The remaining two projects have been completed, and the information presented here summarizes all final conclusions derived from these mathematical investigations. Author (TAB)

N68-35872# Air Force Systems Command, Wright-Patterson AFB, Ohio.
SPECTRAL CHARACTERISTICS OF STIMULATED EMISSION OF GALLIUM ARSENIDE p-n JUNCTIONS
Wang Hsue-wu, Tsuang Wei-hwa, Wang Shou-wu, Chuang Wei-hua, and P'eng Huai-te 25 Oct. 1967 8 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 21, no. 5, 1965 p 1077–1079
(FTD-HT-67-393; AD-673783)

Measurements were made of the fine structure of gallium arsenide laser emission spectra and, also, of applied-current and thermal effects on the operating conditions of the lasers. TAB

N68-35879# California Univ., Berkeley. Lawrence Radiation Lab.
DENSIFICATION AND ELECTRICAL PROPERTIES OF LEAD ZIRCONIUM TITANATE
Bruce F. Semans (M.S. Thesis) Mar. 1968 37 p refs
(Contract N-7405-eng-48)
(UCRL-18126) CFSTI: HC $3.00/MF $0.65

The effect of Al_2O_3 and Bi_2O_3 on the densification and electric properties of lead zirconium titanate (PZT) solid solution was studied. Samples were hot pressed at 850°C under 18,000 psi for two hours. Al_2O_3 was shown to form a low-melting liquid with PbO that had minimal effect on the densification rate and electric properties. The PbO–Al_2O_3 liquid segregated into pockets that did not wet the PZT grain. Bi_2O_3 was shown to lower the temperature at which increased densification occurs as well as lower the coercive field, remnant polarization, and saturation polarization as compared to the undoped material. Although Al_2O_3 was found to segregate, no conclusions on the role of Bi_2O_3 in enhancing the densification process could be made. Author (NSA)

N68-35890# Compagnie Francaise Thomson-Houston, Bagneux (France).
NONLINEARITY IN HYPERFREQUENCY OF SUPERCONDUCTIVE LAYERS [NON-LINEARITES EN HYPERFREQUENCE DE COUCHES MINCES SUPRACONDUCTRICES]
Guy Vernet (Ph.D. Thesis—Paris Univ.) [1967] 115 p refs In FRENCH
CFSTI: HC $3.00/MF $0.65

By generating the third order harmonics of a microwave, the nonlinear relation between electric field and current can be shown. A theoretical model has been built placing the thin film on a cavity so that the field is equal on both sides of the film to study the nonlinear response of thin superconductor tin films in a microwave electric field. The third order harmonics are received by a waveguide and its level is investigated as a function of temperature, incident power and film thickness. Experimental results are given and discussed. ESRO

N68-35891# Compagnie Francaise Thomson-Houston, Bagneux (France).
STUDY OF NONLINEAR POWER PHENOMENA DISTINCT FROM THE GYROMAGNETIC RESONANCE IN POLYCRYSTALLINE FERRITES [ETUDE DES PHENOMENES NON LINEAIRES DE PUISSANCE EN DEHORS DE LA RESONANCE GYROMAGNETIQUE DANS LES MATERIAUX FERRITES POLYCRISTALLINS]
M. Boudemange (Ph.D. Thesis–Paris Univ.) [1967] 106 p refs In FRENCH
CFSTI: HC $3.00/MF $0.65

Power losses, distinct from the main resonance i.e. linked to the second order nonlinear process, in polycrystalline materials are examined. Theories which explain nonlinearity in monocrystal materials and behavior of polycrystal materials at low signal levels are recalled. The author shows how with an electromagnetic cavity a microwave field can be created with low signal level to induce nonlinear power phenomena and to measure magnetic losses in a material by the perturbation theory. ESRO

N68-35928# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATING THERMAL CONDUCTIVITY OF ALLOYED GALLIUM ARSENIDE [ISSLEDOVANIE TEPLOPROVODNOSTI LEGRIROVANNOGO ARSENIDA GALLIYA]
M. I. Aliev, G. T. Akhmedli, and M. A. Alieva 30 Aug. 1967 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk Azerb. SSR, Fiz.-Mat. i Tekn. Nauk (Baku), no. 5, 1964 p 49–55
(FTD-HT-67-198; AD-673787)

Heat conductivity, thermoelectric power, electrical conductivity, Hall constant, and mobility of current carriers were determined at 110-550K in p- and n-type gallium arsenide containing various carrier concentrations. TAB

N68-35955# Aerospace Corp., El Segundo, Calif. Lab. Operations
REFLECTIVITY ENHANCEMENT OF SEMICONDUCTORS BY Q-SWITCHED RUBY LASERS
Milton Birnbaum and Tom L. Stocker May 1968 24 p refs
(Contract F04694-67-C-0158)
(SAMSO-TR-68-283; AD-673875)

Reflectivity enhancement of single-crystal silicon, germanium, gallium arsenide, and indium antimonide and polycrystalline boron and cadmium selenide was observed. The reflectivity variations were produced by irradiating the semiconductor with the output of a Q-switched ruby laser (6943 A) with pulses of 30 and 10 nsec. The reflectivity variations were monitored with a pulsed argon ion laser (mainly 4880 and 5145 A). The effect of surface damage at high power levels produced an irreversible reflectivity decrease. Polished samples of molybdenum and tungsten, when irradiated by

the Q-switched ruby laser light, exhibited irreversible decreases in reflectivity due to surface damage and reversible variations which were attributed to elastic deformation. Reflectivity enhancement of semiconductors was attributed to the formation on the semiconductor surface of a liquid film with metallic properties. Author (TAB)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-35072*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE AND STABILITY CHARACTERISTICS OF NITROGEN TETROXIDE-HYDRAZINE COMBUSTORS
Martin Hersch Washington Sep. 1968 23 p refs
(NASA-TN-D-4776) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Studies were conducted to determine the effects of various design and operating parameters on storable propellant rocket combustion. An injector incorporating like-on-like doublets forming parallel sheets achieved 95 percent of theoretical performance and gave best stability. Triplet injectors with unlike impingement had poorest stability characteristics. Increasing combustor length improved performance for parallel sheet but not for triplet injection. Effects of contraction ratio, propellant flow rate, and chamber pressure on performance were small. It was concluded that unlike impingement of hypergolic propellants may be initiating cause of high-frequency instability. Author

N68-35371# Coating and Chemical Lab., Aberdeen Proving Ground, Md.
INVESTIGATING PETROLEUM FUEL-WATER CONTACT INTERACTION EFFECTS Final Report
M. E. Lepera Jul. 1968 24 p refs
(CCL-250; AD-673110)

An investigation was conducted to define the water-reactive characteristics of petroleum fuels following several reported problems resulting from fuel-water interaction. Samples of petroleum fuels, both commercial and specification grade, were evaluated for water-reactivity using selected test procedures. Additional studies were performed with the WSIM procedure (Fed. Test Method Std. No. 3256.1) to define the effects of hydrocarbon composition on WSIM index ratings. In addition, the evaluating of fuel samples necessitated the modification of the WSIM method to permit a realistic assessment of their water-reactive properties. Of all samples evaluated, diesel fuels as a class exhibited the greatest degree of water-reactivity. Author (TAB)

N68-35471# Naval Ammunition Depot, Crane, Ind.
IMPROVED ILLUMINATING FLARE
Bernard E. Doude Jul. 1968 28 p refs
(RDTR-121; AD-673081)

Data are presented to show that a less expensive magnesium can be used to make an illuminating flare candle which generates at least as much light as conventional compositions. The composition utilizes an improved binder. Author (TAB)

N68-35591*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PROPELLANT SELECTION FOR SPACECRAFT PROPULSION SYSTEMS. VOLUME 1: RESULTS, CONCLUSIONS, AND RECOMMENDATIONS Final Report, 5 Jul. 1967–5 Jul. 1968
30 Aug. 1968 74 p
(Contract NASw-1644)
(NASA-CR-96743; K-19-68-6, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 21I

A detailed comparison of the storability and performance of high-energy liquid propellants was performed for a wide range of near-earth and interplanetary missions. Emphasis was placed on detailed thermodynamic, pressurization, and structural analyses of representative vehicle systems. Specific propellants investigated were F_2/H_2, O_2/H_2, FLOX/CH_4, OF_2/CH_4, F_2/NH_3, OF_2/B_2H_6, ClF_5/MHF-5, and N_2O_4/A-50. Major conclusions of this study are as follows: (1) all candidate propellants can be stored nonvented for the Mars Orbiter and MEM missions; (2) space storables yield propulsion vehicle systems 20 percent or more lighter than earth storables for the missions analyzed; (3) fluorine/hydrogen yields the lightest weight pump-fed propulsion vehicle system; (4) OF_2/B_2H_6 yields the lightest weight pressure-fed propulsion vehicle system; (5) all of the propellants are relatively insensitive to variations in mission duration, propellant tank surface coating, insulation degradation, and spacecraft orientation. H_2 is affected more than space storables. Author

N68-35592*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PROPELLANT SELECTION FOR SPACECRAFT PROPULSION SYSTEMS. VOLUME 2: MISSIONS AND VEHICLES Final Report
30 Aug. 1968 209 p refs
(Contract NASw-1644)
(NASA-CR-96988; K-19-68-6, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 21I

Mission analyses leading to the selection of two representative spacecraft stages are presented; and both the Voyager baseline and Mars Excursion Module baseline descriptions are included. The procedure for the stage analysis is given; and details are included for Mars Orbiter stage and Mars Excursion Module ascent stage investigations, including stage design aspects, thermodynamics and pressurization analyses, and propulsion. Results of a sensitivity analysis for the Mars Orbiter mission are described, as are ground support equipment and operations related to the missions and vehicles. The analysis was made using propellants representative of cryogenics, space storables, and earth storables. M.W.R.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-35101*# Northern Research and Engineering Corp., Cambridge, Mass.
ANALYSIS OF GEOMETRY AND DESIGN POINT PERFORMANCE OF AXIAL FLOW TURBINES. 1: DEVELOPMENT OF THE ANALYSIS METHOD AND THE LOSS COEFFICIENT CORRELATION
A. F. Carter, M. Platt, and F. K. Lenherr Washington NASA Sep. 1968 113 p refs
(Contract NAS3-9418)
(NASA-CR-1181) CFSTI: HC $3.00/MF $0.65 CSCL 21E

The development of a stream-filament analysis procedure is presented and a correlation of total-pressure-loss coefficients which forms the basis for a computer program with which the geometry and design-point performance of axial turbines is

investigated. Since one of the principal features of the analysis procedure is the solution of the radial equilibrium equation taking into account radial gradients of enthalpy and entropy, the computer program based on this analysis will provide the turbine designer with the freedom to consider arbitrarily selected distributions of tangential velocities and radial distributions of work output as analysis variables. In addition, with the incorporation of a total-pressure-loss coefficient correlation, the computer program which results from the analysis can be used for a systematic investigation of the performance of alternative turbine designs for specified design requirements. Author

N68-35115*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SIMPLIFIED EQUILIBRIUM HYDROCARBON-AIR COMBUSTION GAS MODEL FOR USE IN AIR-BREATHING ENGINE CYCLE COMPUTER PROGRAMS
Vincent R. Mascitti Washington Sep. 1968 48 p refs
(NASA-TN-D-4747) CFSTI: HC $3.00/MF $0.65 CSCL 21A

Details are given on a simplified hydrocarbon–air combustion gas model, including the effects of dissociation for convenient use in engine cycle computer programs. The generalized model reduces to the hydrogen–air system as well as to the dissociating–air system. The exclusion of chemical species containing atomic nitrogen allows a considerable simplification of the composition equations. The thermodynamic properties of stoichiometric combustion of the kerosene–air and hydrogen–air systems are computed with the simplified model and compared with those of more comprehensive gas models. In addition, the effect of the neglected chemical species on the performance of an idealized subsonic combustion ramjet is presented. The simplified gas model has been used to define the limiting conditions for solid carbon and ammonia formation for fuel-rich gas mixtures. A computer program listing of the calculation procedure for the simplified gas model is presented. Author

N68-35228# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROBLEM OF THE INFLUENCE EXERTED BY THE RELEASE OF COOLING AIR FROM BLADES INTO THE FLOWTHROUGH PORTION OF A GAS TURBINE ON THE EFFICIENCY OF THE LATTER [K VOPROSU O VLIYANII NA EFFEKTIVNOST' GAZOVOY TURBINY VYPUSKA V YEYE PROTOCHNUYU CHAST' OKHLAZHDAYUSHCHEGO VOZDUKHA IZ LOPATOK]
Ye. N. Bogomolov 13 Sep. 1967 19 p refs Transl. into ENGLISH from Izv. Vyssh. Uchеb. Zaved., Aviats. Tekhn. (Kazan), no. 2, 1966 p 49–58
(FTD-HT-67-303; AD-673231)

An approximate theoretical investigation was made of the effect on the efficiency of a gas turbine stage of the discharge of blade cooling air from the rotor or nozzle blades into the main gas stream. The investigation, based on general turbomachinery and gas dynamic theories, consisted in comparing the efficiencies of geometrically and aerodynamically identical turbine stages with and without the cooling air discharge. In addition, an analysis was made of the process of mixing the cooling air with the gas stream. The obtained results indicate that at high air-to-gas pressure ratios, the discharge of air from the nozzle blades can have a positive effect on turbine efficiency. A formula is derived for calculating the power generated as a result of the cooling air discharge. Author (TAB)

N68-35235# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESIGN PRINCIPLES OF ROCKET-RAMJET ENGINES FOR UNMANNED FLIGHT VEHICLES
B. V. Orlov, G. Yu. Mazing, A. L. Reydel', M. N. Stepanov, and Yu. N. Topcheyev 12 Jul. 1968 506 p refs Transl. into ENGLISH of the Book "Osnovy Proyektirovaniya Raketno-Pryamotochnykh Dvigateley Diya Bespilotnykh Letatel'nykh Apparatov" Moscow, Izv. Mashinostr., 1967 p 1–480
(FTD-MT-24-108-68; AD-672900)

The book, which is a training aid for technical college students, contains basic information on rocket-ramjet engines for unmanned flight vehicles and also calculated dependences and typical solutions used during their designing. The book is written on the basis of journalistic articles and monographs published in the domestic and foreign press. Much emphasis is placed on overall designing of rocket-ramjet engines (RPD), including engineering methods of calculating outlet characteristics, and selection of type of propellant, and also on determining optimum characteristics of the flight vehicle and automatic control systems. The proposed methods of calculating optimum parameters of flight vehicle, RPD, and automatic control systems ensure maximum flight range. Selection of RPD correcting devices and parameters of automatic control systems is produced on the basis of frequency response methods. When calculating nonlinear characteristics of control system units there is used the method of harmonic linearization, making it possible to determine the region of steady states and natural vibrations in RPD. Automatic control systems are examined which ensure engine antistall conditions and prevent separation of flow at the diffuser. Designing method is accompanied by numerous examples and calculations. There are given some typical configurations and positive solutions of elements of rocket-ramjet engines and their automatic control systems. Author (TAB)

N68-35407# General Motors Corp., Indianapolis, Ind. Allison Div.
PRELIMINARY DESIGN STUDY OF CONVERTIBLE FAN/SHAFT ENGINES Final Report
R. P. Atkinson and C. C. Raymond Apr. 1968 190 p refs
(Contract DAAJ02-67-C-0070)
(EDR-5640; USAAVLABS-TR-68-26; AD-673148)

The report presents the results of a study of a large number of conceptual arrangements for a convertible fan/shaft engine applicable to advanced rotary-wing aircraft. Fan/shaft power transfer methods were examined and defined. Various methods of fan unloading to minimize or eliminate thrust at hover and to reduce the parasitic fan power were explored. Engine sizing to meet the dual requirements of shaft power and fan thrust was accomplished, and a control system for coordinating shaft power and fan thrust was defined. Performance is presented for supercharged and nonsupercharged gas generator arrangements with various forms of variable fan geometry and decoupling. Author (TAB)

N68-35594*# North American Rockwell Corp., Los Angeles, Calif.
ANALYSIS OF PERFORMANCE CHARACTERISTICS IN GROUND EFFECT OF A LARGE SCALE V/STOL MULTI-FAN-IN-WING TRANSPORT MODEL
R. J. Oberto, D. J. Renselaer, and D. L. Alfano Washington NASA Oct. 1968 130 p ref
(Contract NAS2-4352)
(NASA-CR-1180) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Performance data obtained from static tests in ground effect of a large multi-fan-in-wing V/STOL transport model are described. The data include plots of propulsion systems performance, force and moment characteristics, and induced thermal conditions. Major test variables were height above ground plane, lift/cruise (L/C) nozzle angle, fan louver angle, fan speed, L/C engine power, and operations with L/C nozzles and fans in combination, L/C nozzles alone, and fans alone. Author

N68-35694*# Rocketdyne, Canoga Park, Calif.
J-2 ENGINE PERFORMANCE ANALYSIS FLIGHT AS-501 (APOLLO 4) S-II AND S-IVB STAGES
17 May 1968 325 p
(Contract NAS8-19)
(NASA-CR-61991; R-7450-1) CFSTI: HC $3.00/MF $0.65 CSCL 21H

This report presents the flight performance results of J-2 engines J2026, J2028, J2030, J2035, and J2043 in the S-II stage, and J-2 engine J2031 in the S-IVB stage of the AS-501 (Apollo 4) Saturn V flight vehicle. Included are the engine start transients, mainstage performance, and cutoff transients for the S-II and S-IVB stages, as well as the environmental conditions during the orbital coast period between the initial start and restart of the J-2 engine in the S-IVB stage. Author

N68-35711# Massachusetts Univ., Amherst. School of Engineering.
OPTIMIZATION OF A HYDRO-MAGNETIC COLLOID PROPULSION SYSTEM. PART 1. MOTON OF COLLOID PARTICLES IN A FLUID FLOW DUE TO AN APPLIED MAGNETIC FIELD
H. U. Hwang, J. G. McGowan, and S. N. B. Murthy May 1968 93 p refs
(Contract N00014-68-A-0146)
(THEMIS-UM-68-1; AD-672930)

The general problem of motion of colloid particles in a fluid flow due to an applied magnetic field may be stated as follows: Given a fluid flow with a known mass and volume fraction of colloids and with known velocity and number density distributions, to determine the manner in which the velocity and momentum of the two phases change along the direction of flow when a magnetic field of known orientation and strength is applied. Introducing a number of approximations (pertaining mainly to the distribution of the applied field, particle motion and particle agglomeration) the change in the momentum of the fluid is calculated for given applied fields and particle and fluid velocity and particle size distributions. The critical parameter of operation is the position in the field where the particles may come to rest. The influence of chosen system parameters on such a condition of operation was conducted and is expected to lead to an optimization study. Author (TAB)

N68-35729*# CETEC Corp., Mountain View, Calif.
AN EVALUATION OF AFT-END IGNITION FOR SOLID PROPELLANT ROCKET MOTORS
J. D. Kilgroe, R. E. Fitch, and J. L. Guenther Sep. 1968 291 p refs
(Contract NAS3-10297)
(NASA-CR-72447; CETEC-2008-FR) CFSTI: HC $3.00/MF $0.65 CSCL 21B

A program for the evaluation of aft-end ignition of solid propellant rocket motors was conducted to determine the igniter design and placement parameters which give adequate ignition characteristics while avoiding motor overpressurization. Nine instrumented solid rocket motor aft-end ignition tests were performed. The results demonstrated that, by correct design and placement of the fixed aft-end igniter, satisfactory ignition times can be achieved without overpressurization. However, nozzle pressure oscillations, which arise from interaction of the igniter and motor flows, were found to present a serious problem which remains to be solved. An analytical model was developed which predicts the igniter parameters which avoid overpressurization. Author

N68-35764*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATIC PERFORMANCE OF AN AUXILIARY INLET EJECTOR NOZZLE FOR SUPERSONIC-CRUISE AIRCRAFT
George D. Shrewsbury and John R. Jones Washington Oct. 1968 41 p refs
(NASA-TM-X-1653) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A model of an auxiliary inlet ejector nozzle was tested in the Lewis Research Center's static test facility over a range of nozzle pressure ratios of approximately 1.5 to 17. The model diameter was 33 cm. Secondary flows of from 0 to 10 percent of the primary nozzle flow were investigated. Configurations simulating takeoff, transonic acceleration, supersonic acceleration, and supersonic cruise were tested. The takeoff configurations were evaluated with and without noise suppressor chutes. Author

N68-35828*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
DEFINITION OF A RESISTOJET CONTROL SYSTEM FOR THE MANNED ORBITAL RESEARCH LABORATORY. ADDENDUM TO VOLUME 5: 720 HOUR RESISTOJET LIFE TEST Final Report
R. J. Page (Marquardt Corp., Van Nuys, Calif.), R. A. Short (Marquardt Corp., Van Nuys, Calif.), and R. V. Greco Sep. 1968 97 p refs
(Contract NAS1-6702)
(NASA-CR-66604A; DAC-58134) CFSTI: HC $3.00/MF $0.65 CSCL 21E

Six-10 mlbf resistojet thrustors using the high-temperature (2400°K) rhenium technology have successfully undergone an initial 720-hour life test. Four units were tested on ammonia (NH_3) and two on hydrogen (H_2) at progressively increasing wall temperature from ≈ 1800 to 2400°K. The ammonia thrustors achieved a measured specific impulse of 320 sec. It is estimated that the measured value of 320 sec corresponds to at least 380 sec in space. An unknown cell-pressure effect, particular to the resistojet low Reynolds number nozzle, is believed to have caused the lower measured value. The units operating on hydrogen did not achieve the specific impulse objective of 720 sec (on a measured basis) but did operate at the same wall temperature as the ammonia units. A measured specific impulse of 550 sec was achieved on hydrogen. It is believed that this measured value corresponds to at least 660 sec in space (for the reasons stated above). Author

N68-35862*# Rocketdyne, Canoga Park, Calif.
J-2 ENGINE AS-502 (APOLLO 6) FLIGHT REPORT S- 2 AND S- 4B STAGES. VOLUME 2: S- 2 STAGE FAILURE ANALYSIS
17 Jun. 1968 296 p
(Contract NAS8-19)
(NASA-CR-61992; R-7450-2; V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The results of a postflight analysis of the premature shutdown of the J-2 engines 202 (J2044) and 203 (J2058) due to fuel system failure are presented. Flight data and engine test data were evaluated. The report contains a summary of S-2 events from vehicle liftoff through S-2 staging, cutoff data, anomalies, failure modes, and hypotheses. K.W.

N68-35933*# Rocketdyne, Canoga Park, Calif.
J-2 ENGINE AS-502 (APOLLO 6) FLIGHT REPORT S- 2 AND S- 4B STAGES. VOLUME 3: S- 4B STAGE FAILURE ANALYSIS
17 Jun. 1968 194 p
(Contract NAS8-19)
(NASA-CR-61993; R-7450-2, V. 3) CFSTI: HC $3.00/MF $0.65 CSCL 21H

J-2 engine J2042, installed on the S-IVB stage of the AS-502 vehicle, failed to achieve restart during flight on 4 April 1968. This report presents the results of the flight data analysis

and the engine verification test program conducted to demonstrate the failure mode. Analysis of flight data indicated that the augmented spark igniter fuel line had failed, allowing burnout of the igniter, thus preventing engine restart. Verification tests on an R&D J-2 engine demonstrated the predicted events. The analysis and verification tests, therefore, provide proof of the failure mode which prevented AS-502, S-IVB restart. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-35210*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

SOME HIGH ALTITUDE COSMIC RAY EXPERIMENTS USING A SMALL SUPERCONDUCTING MAGNET

Jared A. Anderson (Lawrence Radiation Lab., Berkeley, Calif.), Richard Eandi, Robert L. Golden, Donald E. Hagge, and Richard Kurz Berkeley, Calif. Calif. Univ. Mar. 1968 24 p Prepared by Lawrence Radiation Lab., Berkeley, Calif.
(Contract W-7405-eng-48)
(NASA-TM-X-61255; UCRL-18149) CFSTI: HC $3.00/MF $0.65
CSCL 20H

Two experiments of astrophysical importance are suggested: the determination of the cosmic-ray electron energy spectrum between 10 and 100 GeV and the measurement of the charge composition of cosmic rays in a similar energy region. Both experiments would utilize magnetic momentum analysis, using a small superconducting magnet suitable for balloon flights to high altitudes. Author (NSA)

N68-35362#

PRELIMINARY RESULTS OF SOLAR X-RAY RESEARCH WITH THE COSMOS-166

B. N. Vasil'ev, I. A. Zhitnik, V. V. Korneev, V. V. Krutov, S. L. Mandel'shtam et al [1967] 11 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 3, 1968 p 420-431
CFSTI: HC $3.00/MF $0.65

On each orbit after its emergence from the earth's shadow, the Cosmos-166 was oriented towards the sun with 1-2° accuracy; thrice during each orbit the satellite axis intersected the solar disc once at a mean velocity of 0.04°/sec. The purpose of the research was to localize the domains of primary generation of x-rays in the solar corona during solar flares and under quiet sun conditions. Part of the apparatus was an x-ray heliograph with a slit collimator of around 3' angular resolution which swept the solar disc in two mutually-perpendicular directions in the spectrum ranges 2-8 and 8-14 Å, and an x-ray photometer which measured the radiation flux in the 1.5-4, 4.4-6.5, and 8-14 Å spectrum ranges. Preliminary processing of the results shows that x-ray flares originate primarily in domains located above the calcium flocculi; growth in x-radiation flux occurs mainly because of the harder 1.5-4 Å radiation; radiation in the 4.4-6.5 Å band increases within lower limits, and soft radiation in the 8-14 Å band hardly changes. Author

N68-35494#

ON THE SPECTRUM OF PROTON INJECTION FROM SOLAR FLARES

L. N. Miroshnichenko [1967] 3 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 8, no. 3, 1968 p 561-562
CFSTI: HC $3.00/MF $0.65

A diffusion model, used to determine the injection spectrum of protons accelerated by the sun to 10^8 to 10^9 ev energies, takes into account distortions due to scattering of solar particles by inhomogeneities of the interplanetary magnetic field. The diffusion coefficient is dependent on the hardness of the particles and the distance to the sun. Injection spectra for six solar flares observed by either ground neutron monitors or by Explorer satellites are included. M.W.R.

N68-35633*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE EFFECT OF PHOTOMESON PRODUCTION BY THE UNIVERSAL RADIATION FIELD ON HIGH-ENERGY COSMIC RAYS

F. W. Stecker Sep. 1968 12 p refs
(NASA-TM-X-63353; X-641-68-361) CFSTI: HC $3.00/MF $0.65
CSCL 20H

Effect of protons interacting with the high density universal microwave field is considered in order to determine the effect of photomeson production on the cosmic ray spectrum. The strongest final state channels observed for photomeson production have been two particle states, and the particles produced in such states are uniquely determined by conservation of energy and momentum. An equation is included for determining the interaction inelasticity of the single pion production. Collision and attenuation mean free paths for cosmic ray photomesons are derived. It is noted that characteristic lifetime drops from 10^{12} years at 3×10^{10} GeV to 10^{10} years at 6×10^{10} GeV, 10^9 at 10^{11} GeV, and a minimum of 5×10^7 near 10^{12} GeV; and that the sharp drop is caused by a sharp increase in photoproduction region of pion-nucleon resonance combined with a steady increase in inelasticity. M.W.R.

N68-35732*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

22 KEV SPECTRUM OF X-RAYS FROM THE CRAB NEBULA AND THE DIFFUSE BACKGROUND NEAR GALACTIC ANTICENTER

Elihu A. Boldt, Upendra D. Desai, and Stephen S. Holt Sep. 1968 26 p refs
(NASA-TM-X-63351; X-611-68-353) CFSTI: HC $3.00/MF $0.65
CSCL 03B

Data are presented from a rocket-borne exposure to x-rays from the Crab Nebula and its apparently source-free neighborhood on the celestial sphere near galactic anticenter. With ≈2 keV resolution, the Crab Nebula is found to have a structureless spectrum which is consistent with a power law of index $-1.93 \pm .05$ in the differential photon flux between 2-20 keV, in substantial agreement with results of investigators using balloon-borne detectors at higher energies. The diffuse x-ray background is found to exhibit a harder spectrum than the Crab Nebula in the same energy range. The 2-20 keV background spectrum, with index $-1.3 \pm .1$, is significantly flatter than that reported at higher energies. Author

N68-35750*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE INFLUENCE OF VARYING SOLAR FLUX ON IONOSPHERIC TEMPERATURES AND DENSITIES: A THEORETICAL STUDY

J. R. Herman and S. Chandra Jul. 1968 53 p refs Submitted for Publication
(NASA-TM-X-63345; X-615-68-285) CFSTI: HC $3.00/MF $0.65
CSCL 04

The electron continuity and heat conduction equations for electrons, ions, and neutral species are solved simultaneously for specified boundary conditions and values of the solar flux. These solutions have yielded a set of self-consistent steady state profiles for a variety of midday solar conditions that are in agreement with

observational data. To produce these profiles only the boundary conditions and solar flux are used as variable parameters of the problem. It is shown that the neutral temperature and the resulting neutral gas composition play a dominant role in determining the charged particle density and temperature profiles. This leads to a picture of the solar cycle variation where composition changes in the neutral gas (introduced at the lower boundary) must be combined with the solar flux variation to produce physically reasonable results. Of the five neutral gases used (N_2, O_2, O, He, H) the atomic oxygen density variations are shown to be most effective in producing the observed trends for all the temperatures and densities in the E and F regions. Author

N68-35889# Harvard Coll. Observatory, Cambridge, Mass.
RESEARCH DIRECTED TOWARD THE OBSERVATION AND INTERPRETATION OF SOLAR PHENOMENA Final Report, 1 May 1967–30 Apr. 1968
Barbara Bell, Howard L. Damastus, and Donald H. Menzel May 1968 19 p
(Contract F19628-67-C-0247)
(AFCRL-68-0316; AD-673911)

The first section describes research at Harvard in two major categories: (1) Analyses of solar observations made at Sacramento Peak and elsewhere of the green coronal line, and of sunspots. (2) Theoretical studies in magnetohydrodynamics, leading toward devel'1opment of a model for sunspots, and in atomic theory, on the intensities of spectral lines for improved interpretation of the solar spectrum. The second section reviews the operation at Sacramento Peak of the optical solar patrols of flares in the light of Ha, of sunspots in white light, and of the coronal emission lines by spectrograph and cinematograph; it also notes a photographic observation of a flare in white light. Author (TAB)

N68-35892# Commissariat a l'Energie Atomique, Saclay (France). Service d'Electronique Physique.
BALLOON BORNE SPARK CHAMBER EXPERIENCES [EXPERIENCES EN BALLONS AVEC LES CHAMBRES A ETINCELLES]
Bernard Agrinier and Bruno Parlier 16 Mar. 1967 22 p refs In FRENCH Presented at the School on the Technol. of Space Expt. Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

Knowledge of cosmic ray spectra and origin can be improved by experiments with spaceborne spark chambers. Different balloon-borne experiments carried out in Europe as well as in the United States are analyzed. Satellite-borne projects are discussed. ESRO

N68-35999*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PHOTOELECTRON FLUX IN THE TOPSIDE IONOSPHERE MEASURED BY RETARDING POTENTIAL ANALYZERS
B. C. Narasinga Rao and J. L. Donley Sep. 1968 15 p refs
(NASA-TM-X-63358; X-615-68-381) CFSTI: HC $3.00/MF $0.65
CSCL 04A

Reported are results of measurements of photoelectron flux in the topside ionosphere which were made using retarding potential analyzers aboard the Explorer XXXI and OGO-IV satellites. S.C.W.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-34823 Indiana Univ., Indianapolis.
THEORETICAL MODELS OF NOVAE
Warren Morgan Sparks (Ph.D. Thesis) 1967 188 p
Available from Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 67-15165

A study of the effects of a sudden injection of internal energy into an envelope that is radiative and at hydrodynamic equilibrium is presented. The time variation of the pressure, temperature, density, position and other physical quantities is determined at many fixed mass points. Two types of ejections which can give rise to novae are found. The flash nova, T. Coronae Borealis, has a very fast rising and falling light curve and a rapidly decreasing velocity curve. It is found that a shock wave which imparts a velocity which is greater than the escape velocity to the outer layers of the star will produce this behavior. A less rapid rising and falling light curve and a nearly constant velocity are characteristic of the ordinary nova, GK Persei. These features will result when the stellar material is forced outward from the star by the increase of pressure in the region where the internal energy is injected. Dissert. Abstr.

N68-34836# Joint Publications Research Service, Washington, D. C.
ASTRONOMY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, no. 187 4 Sep. 1968 p 1–6 Presented at the Conf. on Solar Supercorona and Interplanet. Plasma, 22–25 Apr. 1968 (See N68-34835 22-13)

Sino-Soviet publications in the field of astronomy are reported. Cited are news items on a conference on solar supercorona and interplanetary plasma which was held in Moscow (April 1968), and studies of two new novae in the constellations Delphinus and Vulpecula which are being conducted by the Shemakhinskaya Astrophysical Observatory of the Academy of Sciences (Azerbaydzhan, U.S.S.R.). Included are abstracts of scientific articles on quasi-periodic low frequency solar radio emission fluctuations; photodissociation of C_2 molecules in cometary atmosphere; radiative transfer in spectral lines; reflectivity of upper layer of the moon; and photoelectric determination of nighttime transparency. S.C.W.

N68-34869 National Lending Library for Science and Technology, Boston Spa (England).
SOME STATISTICAL INVESTIGATIONS OF CLOSE BINARY SYSTEMS [NEKOTORYE STATISTICHESKIYE ISSLEDOVANIYA TESNYKH DVOINYKH SISTEM]
M. A. Svechnikov Sep. 1968 18 p refs Transl. into ENGLISH from Peremen. Zvezdy (SSSR), v. 16, no. 2, 1967 p 276–286
(RTS-4774) Available from Natl. Lending Library, Boston Spa, Engl.: 27s 6d

Herzsprung-Russell diagrams were derived for divided systems and semi-detached systems in close binaries by using card catalogue data containing absolute elements, masses, and luminosities of 179 eclipsing variable stars. These included 44 detached systems of the main sequence, 53 semi-detached systems, and 16 detached subgiants with the main components located close to the main sequence. Systems were divided into groups according to the position of their components on the diagrams, and certain irregularities were discovered in the distribution of main sequence stars according to their masses. Variations of period, orbital momentum, and other characteristics were investigated for variation in mass-component ratio of semi-detached systems and of undersized subgiants. Many nonstationary phenomena in close binary systems were connected with the ejection of matter by one of the components of the system. Semi-detached systems and detached subgiants are not considered to represent two successive stages of evolution; they are systems of different evolutions. M.W.R.

N68-34870* National Aeronautics and Space Administration, Washington, D. C.
EXPLORING SPACE WITH A CAMERA
Edgar M. Cortright, ed. and comp. 1968 227 p
(NASA-SP-168) GPO: $4.25 CSCL 22A

Representative space photographs from among the thousands of pictures returned to earth during the past decade comprise this volume, which is presented in sections devoted to photography above the atmosphere, to the moon and beyond, and man's venture into space. Some of the pictures were made by man-directed cameras, while others were relayed back to earth by unmanned spacecraft. Primarily a collection representing space accomplishments of the United States, the volume also includes some photographs taken during Soviet space probes. Cloud cover, storms, and other meteorological phenomena are shown in the photographs, for which written texts are included along with comments by NASA and other scientific personnel. Surveyor and Orbiter shots of the moon include photographs of craters, mares, and other formations. Shots from various Gemini flights depict the docking of the Agena target, man's space walk, the earth's features, and space phenomena. An appendix includes details of the major spacecraft launched by the United States. M.W.R.

N68-34927*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ACHIEVEMENTS IN PLANETOLOGY, 1967
Jul. 1968 219 p refs
(NASA-TM-X-63337; X-644-68-282) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Studies made in 1967 of the planets and their satellites, the asteroids, and meteorites are reviewed under the general headings of the planets, terrestrial geochemistry and geophysics, the moon, impact cratering and metamorphism, stony-iron meteorites, and stony meteorites and tektites. Studies of Earth, Mars, Mercury, Venus, and the major planets are reported; and spacecraft observations and optical astronomy techniques for reporting lunar characteristics are presented. Chemical analysis performed by experiments aboard Surveyor V on lunar samples was considered the most spectacular scientific achievement with regard to the moon studies. Also considered important are the clarification of the nature and process of volcanic processes on the moon along with the fact that more volcanic structures are being found on the moon as opposed to more impact structures on the earth. References were made to 332 studies from the literature, and numerous illustrative materials are included. M.W.R.

N68-34928# National Academy of Sciences–National Research Council, Washington, D. C.
PLANETARY EXPLORATION: 1968–1975. REPORT OF A STUDY BY THE SPACE SCIENCE BOARD, WASHINGTON, D. C., JUNE 1968
Jul. 1968 57 p

Recommendations for planetary explorations are presented in terms of studies dealing with planetary atmospheres, surfaces, and dynamics and interiors; particles, fields, and planetary interactions with the solar wind; and exobiology. In addition to explorations covering a broad range of scientific disciplines, it is recommended that an increased portion of the total NASA budget be devoted to unmanned planetary flights, and that radar astronomy be an integral part of the planetary program. Since the planetary program is limited by resources rather than technology, competent personnel, or ideas, priorities for space exploration must be examined with great care and mission redundancy undertaken only when a clear gain in scientific information can be expected. Small spacecraft for planetary missions, such as Pioneer missions to Jupiter and Pioneer/IMP-class spinning spacecraft for orbiting Venus and Mars, are recommended. Larger missions considered necessary are a Mariner Orbiter mission in 1971 and a Mariner-type orbiter and lander mission in 1973; and, in order of descending priority, a Mariner-class Venus-Mercury flyby in 1973, or 1975, a multiple drop-sonde mission to Venus in 1975, and a major Mars landing possibly in 1975. M.W.R.

N68-34937 Indiana Univ., Bloomington.
NUCLEOSYNTHESIS BY THE S-PROCESS IN STARS OF 9 AND 15 SOLAR MASSES
James Gordon Peters (Ph.D. Thesis) 1967 201 p
Available from Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 67-15147

This study combines available sequences of models which describe the evolution of stars of 9 and 15 $M_\odot$ (solar masses) with the details of the processes that produce and capture neutrons. The purpose is to determine the abundances of elements produced by the s-process of stellar nucleosynthesis, i.e., by neutron capture at a rate which is slow compared with that of the intervening β decays. The elements of the iron abundance peak serve as the seed nuclei from which s-elements are synthesized. The s-process reactions are assumed to have no effect on the star's evolution. During hydrogen burning most of the abundant CNO nuclei are converted to N^{14}, which is converted to Ne^{22} during core helium burning. Thus the $Ne^{22}(\alpha,n)Mg^{25}$ neutron source provides a high source-to-seed ratio and occurs after the N^{14} of the core has been consumed. If N^{14} were present, it would act as a neutron poison owing to its high neutron capture cross section, σ. Dissert. Abstr.

N68-34952*# Volt Information Sciences, Inc., Washington, D. C.
VENERA-4 AND THE INTERPRETATION OF RADIO ASTRONOMICAL MEASUREMENTS OF VENUS
A. D. Kuz'min and Yu. N. Vetukhnovskaya Greenbelt, Md. NASA. Goddard Space Flight Center 24 Sep. 1968 10 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 4, 1968 p 590–597
(Contract NAS5-12487)
(NASA-CR-96884; ST-LPS-RA-10753) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The results of AIS "Venera-4" measurements are used for interpreting radio astronomical ground observations. It is shown that radio astronomical data are in good agreement with the model of venusian atmosphere designed on the basis of AIS "Venera-4" data. Water and water vapour content in the atmosphere of Venus is estimated. Some assumptions on the possible physical condition of Venus are submitted. Author

N68-34953*# Volt Information Sciences, Inc., Washington, D. C.
ON THE ANALYSIS OF CHEMICAL COMPOSITION OF MOON'S SURFACE BY DIRECT METHODS
V. P. Konstantinov, M. M. Bredov, and S. V. Uiktorov Greenbelt, Md. NASA. Goddard Space Flight Center 16 Sep. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Fiz. (USSR), v. 181, no. 4, 1968 p 827–829
(Contract NAS5-12487)
(NASA-CR-96885; ST-ACH-LS-10756) CFSTI: HC $3.00/MF $0.65 CSCL 22A

After discussing the indirect methods applied thus far for the study of chemical composition of planet surface layers, the authors refer to a new, express method for making such evaluations, as developed at the Ioffe Institute of Physical Engineering of the USSR Academy of Sciences. It consists in the use of a special apparatus consisting of sealed proportional counters in combination with special filters, detecting the X-ray emission of elements. Author

N68-34960 Illinois Univ., Urbana.
THE DENSITY DISTRIBUTION OF THE RR LYRAE TYPE VARIABLE STARS

Raymond Edwin White, Jr. (Ph.D. Thesis) 1967 152 p
Available from Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 67-11935

For each of two different values of M_B(RR Lyr), +0.5 and + 0.9, a new galaxy-wide, smooth density distribution is found for the field RR Lyrae-type variable stars. Elliptical isodensity contours are generated for the field variables by a different approach to the problem of accurately combining the volume elements in the chosen variable star fields. The thirty-six published variable star fields used by Perek (1950), and later by Plaut and Soudan (1963), are re-inspected for their RR lyrae variables. Two new star fields are added from the literature. One combined field used by Perek is separated into its two separate components. In the resultant 39 systematically searched star fields, a total of 1515 field RR Lyrae variables are recovered for completeness analysis. The values of the local RR Lyrae star density, for the respective values of +0.5 and +0.9 for M_B(RR Lyr), are determined to be 41.0 and 71.6 stars/kpc^3 by graphically interpolating the isodensity contours.
Dissert. Abstr.

N68-34961 Arizona Univ., Tucson.
A RE-EXAMINATION OF THE MK SPECTRAL CLASSIFICATION SYSTEM FOR "A" AND "F" MAIN SEQUENCE STARS
Don Cary Barry (Ph.D. Thesis) 1967 184 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-11955

Using the Steward Observatory Cassegrain spectrograph, over 370 grating spectra (117 A/mm) of A and F dwarfs of widely varying metallic line strength were obtained. One hundred twenty-four of the spectra are of dwarfs lying on the normal m$_1$-(b-y) relation. The 3300A-3900A region of these spectra is studied in order to determine criteria which indicate accurate spectral types. The resulting spectral type vs. criteria table makes it possible to classify the A and F stars at each 0.1 spectral type interval with an r.m.s. error of about 0.1 type in the mid-A stars and decreasing rapidly towards the late F. stars. The available spectra of MK luminosity standards of types A and F are studied for luminosity criteria. The results are given in the form of tables of luminosity class vs. criteria at each 0.5 spectral type. The increased sensitivity of the new criteria makes it possible to classify A and F stars according to luminosity with significantly improved accuracy.
Dissert. Abstr.

N68-34963 Northwestern Univ., Evanston, Ill.
A SPECTROSCOPIC STUDY OF THE B STARS IN THE ASSOCIATION I LACERTA
William Taylor Hughes (Ph.D. Thesis) 1967 68 p
Available from Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 67-15247

Petrie's technique is used to determine absolute magnitudes for stars in the I Lacerta association. The ages and masses of these stars are then estimated by interpolation in Iben's grid of models, using $(B-V)_0$ to determine log T_e and the bolometric correction. It is found that the stars in the dispersed region are on the whole both less massive and older than those in the condensed region. Using Unsöld's method, the He:H ratio is determined for the stars; and it is found that the ratio shows no significant variation and has a mean value of 0.19 ± .03. Equivalent widths of λ4481 of MgI are also measured and it is found that Mg is overabundant with respect to the sun.
Dissert. Abstr.

N68-34966 National Lending Library for Science and Technology, Boston Spa (England).
ON THE CHANGES OF THE SQ-VARIATIONS [OB IZMENCHIVOSTI SQ-VARIATSIV]
Dz. S. Chikovani Sep. 1968 5 p refs Transl. into ENGLISH from Tr. Inst. Geofiz., Akad. Nauk. Gruzinskoy SSR (USSR), v. 26, no. 1, 1966 p 39–43
(RTS-4765) Available from Natl. Lending Library, Boston Spa, Engl.: 12s 6d

Changes in daily solar variations (Sq) were studied from magnetograms taken on 130 quiet days during 1964 at seven magnetic observatories; and Sq(H)-variations were prepared for each day, with variations in H during a 24-hour period indicated by deviations from the midnight value. Day to day changes of Sq(H)-variations in the northern hemisphere sometimes exhibited a planetary nature, and occasionally a purely local nature.
M.W.R.

N68-35162 National Lending Library for Science and Technology, Boston Spa (England).
COLD AND HOT REGIONS IN THE SOLAR ATMOSPHERE [KHOLODNYE I GORYACHIE OBLASTI V SOLNECHNOI ATMOSFERE]
D. A. Kuznetsov and V. E. Stepanov Sep. 1968 23 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Resul'taty Nablyudonii i Issled. V. Period MGSS (USSR), v. 9, no. 4, 1967 p 82–95
(RTS-4712) Available from Natl. Lending Library, Boston Spa, Engl.: 35s

Charts detailing brightness distributions at different levels in the solar atmosphere were analyzed; and distributions of the angles of inclination used were found to depend to a great extent on the model accepted for the facula. Differences found for hydrogen and calcium lines confirmed the possibility that the chromosphere contains elements with different temperatures. Estimates indicated that amplification of radiation from the hydrogen element was accompanied by energy absorption that was 26 times greater than that from the metallic element. Flocculi within or near a group of sunspots consisted of components of different temperatures and radiation intensity; and in the chromosphere, the umbra is surrounded by a ring-shaped hot region. It was assumed that the coronal matter penetrating the chromosphere is extremely heterogeneous in terms of energy.
M.W.R.

N68-35163*# Geological Survey, Washington, D. C.
INTERAGENCY REPORT: ASTROGEOLOGY 6. CHARACTER AND GEOLOGIC HABITAT OF POTENTIAL DEPOSITS OF WATER, CARBON, AND RARE GASES ON THE MOON
Donald P. Elston May 1968 26 p refs
(NASA Order W-12388)
(NASA-CR-96879) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Circumstantial evidence indicated the rim deposits of certain lunar craters may be breccias containing water, carbon, and inert gases. According to a cratering model, the water would be largely recoverable by heating the brecciated rock. Although most of the rocks would contain only 1–2 wt % water, some local deposits would be expected to contain 5 or more wt %; and some of the deposits would contain permafrost. Compositional characteristics and inferred sources of extraterrestrial materials are discussed, as are chemical contents of some meteoritic materials. Attention is given to the general composition of the moon, exogenetic processes, and other geological aspects of lunar materials. Cratering by cometary materials is considered in terms of formation of Messier and Messier A, other dark and intermediate craters, and potential deposits around Tycho. These ejecta around Tycho may constitute a potentially large source of water, and field evidence in the Colombo quadrangle suggests that there are many other potential deposits of water-bearing rocks on the lunar surface.
M.W.R.

N68-35351# Air Force Missile Development Center, Holloman AFB, N. Mex.
THE VALUE OF LARGE, PRELAUNCH CROSS RANGE IN AIRCRAFT-TYPE ORBITAL LAUNCHERS

Howard G. Clark and Richard J. Schulte Sep. 1967 35 p refs
(MDC-TR-67-98; AD-672974)

Many of the space missions postulated for the next decade require execution of orbital rendezvous. Rendezvous vehicles will be needed to perform space rescue, to ferry materials for space platform construction, to supply and service friendly orbiters, and to inspect, capture or destroy hostile satellites. All these missions require that a relatively large payload be delivered into a specified orbit pre-determined by another vehicle - the target. It is the purpose of this paper to show that for maximum payload the rendezvous task can best be performed by staging the interceptor from a mobile, aircraft-type launcher. In particular, this report demonstrates that only two mobile launchers, configured for a cruise radius of 2700 nm, can provide rendezvous capability against any pass of any near-earth satellite orbit. Author (TAB)

N68-35492# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A TREATISE ON INTERPLANETARY NAVIGATION

Hsueh-Sung Chien 30 Aug. 1967 85 p Transl. into ENGLISH from Hsing Chi Hang Hsing Kai Lun (China), 1963 p 189–232
(FTD-HT-67-287; AD-673164)

Contents: The problem of communication in interplanetary navigation (The significance of Communication in interplanetary navigation, The effective power of the communication system in interplanetary navigation, Noise of communication in interplanetary navigation, Information rate, Quantum effect, Equipment requirement of interplanetary communication, Ground receiving antenna, Satellite type communication relay system, Problem of electromagnetic wave propagation, Light wave communication); Re-entry into the atmosphere (The problem of the descent of artificial satellites or space ships, Analysis of re-entry orbits, Two types of re-entry orbits, Heat proof designs, Principle of heatproofing design, Application in interplanetary navigation orbit). TAB

N68-35493*# California Univ., La Jolla.

PRELIMINARY RESULTS OF THE UNIVERSITY OF CALIFORNIA X-RAY EXPERIMENT ON THE OSO-3

Laurence E. Peterson, Hugh S. Hudson, and Daniel A. Schwartz Nov. 1967 28 p refs
(Contract NAS5-3177; Grant NsG-318)
(NASA-CR-96950; UCSD-SP-67-10) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Operational status and some preliminary results are presented for an X-ray experiment on the Orbiting Solar Observatory, OSO-III, which was launched March 8, 1967. The detector consisting of a 5-mm thick scintillation counter of about 10 cm^2 area surrounded by an anti-coincidence shielding collimator, is arranged to look radially outward from the OSO wheel and scan across the sun, sky, and earth with every nominally 2-sec wheel rotation. Data on cosmic and solar X-rays, obtained during the first three months of the experiment's operation, are discussed. Approximately two weeks of solar data were examined, and the outstanding characteristic of the sun in the hard X-ray region is its variability. Observations of the quiet sun and of many small bursts are noted. M.W.R.

N68-35520# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SCATTERING OF LIGHT IN THE ATMOSPHERES OF THE PLANETS [O RASSEYANII SVETA V ATMOSFERAKH PLANET]

I. N. Minin 12 Sep. 1967 11 p refs Transl. into ENGLISH from Uch. Zap. Univ. (Leningrad), v. 22, no. 328, 1965 p 39–43
(FTD-HT-67-266; AD-672907)

The scattering of light off a plane layer with finite optical thickness sub 0 is considered. The layer is bounded below by a reflecting floor and is illuminated with parallel rays incident at a given angle to the normal. The scattering of this light is calculated as arising from molecules (Rayleigh scattering) and from atmospheric aerosols. The motivation for this calculation proceeds from investigation of optical properties of planetary atmospheres, particularly those of earth and Mars. In this work, account is taken of the light polarization in reflection off the atmospheric floor and scattering by the aerosols. Approximate formulas describing the radiation emerging from the planetary atmosphere are obtained. Author (TAB)

N68-35541*# National Aeronautics and Space Administration, Washington, D. C.

THE SIGNIFICANCE OF THE JUPITER SWINGBY MODE FOR INTERPLANETARY MISSIONS

Walter Mueller Sep. 1968 45 p refs Transl. into ENGLISH of the Rept. "Die Bedeutung der Swingby-Technik Am Planeten Jupiter fuer Interplanetare Missionen" Munich, 7 Dec. 1967 Presented at the DGRR Symp. on Interplanet. Space Flight Missions
(NASA-TT-F-11880) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The astrodynamic theory of gravity-assisted interplanetary spacecraft trajectories is discussed, followed by an analytical study of Saturn, Uranus, Neptune, and Pluto missions with gravity assists from Jupiter. Time factors, launch opportunities, and reduced propulsion requirement due to the utilization of the gravity field are covered. Transfer trajectories utilizing several gravity fields for a multiple interplanetary mission are considered as well as solar missions and missions to comets. Problems connected with scientific purpose, trajectory accuracy, and mission duration are briefly pointed out. Author

N68-35546*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

PHOTOMETRIC INVESTIGATIONS OF THE LUNAR SURFACE

V. G. Fesenkov Redstone Arsenal, Ala. Redstone Sci. Inform. Center Apr. 1968 4 p ref Transl. into ENGLISH from Astron. Zh. (USSR), v. 5, 1929 p 219–234 Sponsored jointly by the Army
(NASA-TM-X-61275; RSIC-796; AD-671818) CFSTI: HC $3.00/MF $0.65 CSCL 03A

The aim of this paper is the determination of the law according to which the light is reflected from the different parts of the lunar surface under various angles of incidence, reflection and phase. The photograms of the moon obtained by surovtseff in the focus of the normal astrograph of the tashkent astronomical observatory were measured at the Astrophysical Institute of Moscow with the harmann microphotometer. The photographic densities obtained with this instrument were transformed into brightness of the corresponding points by means of the scale of tubular photometer printed on each plate exactly with the same exposure. The extrafocal images of the polar star photographed on the same plates with many different exposures were utilized for the determiniation of the same unit of brightness. The brightness of the different points of the moon were corrected for effect of halation. It is found that our photometrical determinations for all phases from 0 degrees up to 140 degrees may be represented in a very satisfactory way by a mathematical equation which is a modification of the very well known Lommel-Seeliger's formula. TAB

N68-35587*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RESONANT PERTURBATIONS OF EARTH SATELLITES IN 2 DAY COMMENSURABLE ORBITS

C. A. Wagner Sep. 1968 118 p refs
(NASA-TM-X-63356; X-643-68-373) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Examination of satellite orbits with commensurable periods near integer multiples of one day offers the only possibility of

observing the strong dominant resonance effects of most of the longitude gravity harmonics (H_{lm}) of order (m) higher than 16. A survey of existing satellite elements in June 1968 has revealed two 2-day commensurable orbits, one of 13.5 and the other of 14.5 revolutions a day, which show resonant perturbations greater than 100 km along track due to $H_{27,27}$ and $H_{38,29}$ respectively. Twelve other satellites in orbits of 8.5, 9.5, 10.5, 12.5, 13.5, and 14.5 revs/day should be suffering resonant perturbations greater than 1 km along track. The dominant resonant gravity harmonics on these orbits are: $H_{19,17}$ (8.5 revs/day, 1 orbit), $H_{19,19}$ (9.5 revs/day, 2 orbits), $H_{21,21}$ (10.5 revs/day, 1 orbit) $H_{25,25}$, $H_{26,25}$ and $H_{28,25}$ (12.5 revs/day, 3 orbits), and $H_{30,29}$ (14.5 revs/day, 2 orbits). Close tracking of these objects over their resonant beat periods which range from 13 to hundreds of days should yield valuable new information about the earth's high order gravity field. Author

N68-35588*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A UNIFIED FORM OF LAMBERT'S THEOREM

E. R. Lancaster and R. C. Blanchard. Sep. 1968 24 p refs

(NASA-TM-X-63355; X-643-68-368) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A unified of Lambert's theorem is presented which is valid for elliptic, hyperbolic, and parabolic orbits. The key idea involves the selection of an independent variable x and a parameter q such that the normalized time of flight T is a single-valued function of x for each value of q. The parameter q depends only upon known quantities. If T is less than the time of flight for one complete revolution, it is a monotonic function of x for each q, making possible the construction of a simple algorithm for finding x, given T and q. Detailed sketches are given for T(x,q) and formulas developed for the velocity vectors at the initial and final times. Also included is a careful derivation of the classical form of Lambert's equations, including the multirevolution cases. Author

N68-35599*# Volt Information Sciences, Inc., Washington, D. C.

STUDY OF THE PROPAGATION OF DECIMETER RADIOWAVES IN THE ATMOSPHERE OF VENUS WITH THE AID OF AIS "VENERA 4"

M. A. Kolosov, O. I. Yakovlev, and A. I. Yefimov Goddard Space Flight Center, Greenbelt, Md. NASA 8 Oct. 1968 3 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Geofiz., (Moscow), v. 182, no. 1, 1968 p 93-94

(Contract NAS5-12487)

(NASA-CR-97015; ST-PA-RWP-10762) CFSTI: HC $3.00/MF $0.65 CSCL 03B

This study is based on the approximate estimates of the inhomogeneity of Venus troposphere's index of refraction. It is found that in the troposphere of Venus the latter's fluctuations are greater by a factor of 10 than in the Earth's troposphere. It is emphasized that the data presented here have the character of approximate estimates. Author

N68-35613*# TRW Systems, Redondo Beach, Calif.

DERIVATION OF EQUATIONS: GENERALIZED SPACECRAFT SIMULATION. VOLUME 1: DYNAMIC EQUATIONS

J. L. Palmer 15 Feb. 1967 206 p refs

(Contract NAS5-10189)

(NASA-CR-96954; TRW-06464-6004-T000, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

This document contains the derivation of a set of nonlinear, large-angle dynamics equations for an N-body system, including gravity gradient and disturbance torques and forces. The basic spacecraft configuration consists of N connected bodies. Body 1 is considered the main spacecraft structure wherein the orbital experiments are housed. The disturbance parameters considered include solar radiation forces and torques, thermal bending torques, aerodynamic forces and torques, and magnetic torques. Magnetic disturbances are based upon a simple dipole magnetic field representation. Thermal bending, both in plane and out of plane, is computed for all booms. Solar and aerodynamic disturbances include the effects of the thermally deflected boom, and are based upon up to four basic shapes for each body. The shapes considered are spheres, flat plates, cylinders, and parallelepipeds. In addition, the equations necessary to incorporate the effects of solar eclipse, boom deployment, and magnetic hysteresis dampers, have been derived and presented in the form required for digital programming. Author

N68-35616*# TRW Systems, Redondo Beach, Calif.

DERIVATION OF EQUATIONS: GENERALIZED SPACECRAFT SIMULATION. VOLUME 2: CONTROL SYSTEM EQUATIONS

J. L. Palmer 15 Feb. 1967 117 p refs

(Contract NAS5-10189)

(NASA-CR-96953; TRW-06464-6004-T000, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22A

This document defines and presents the equations for a generalized active control system. The basic spacecraft configuration consists of N connected bodies. Body 1 is considered the main spacecraft structure wherein the orbital experiments are housed. Each of the N-1 auxiliary bodies is assumed to be attached to Body 1 at an arbitrary single point, to have up to three degrees of rotational freedom relative to Body 1, and no interconnection with the other auxiliary bodies. The relative rotation of the auxiliary bodies, with respect to the main body, is assumed to take place about a gimballed hinge. The sensor routines provide for two rate gyros, two horizon scanners, and two two-axis sun sensors. Sensors dynamics and/or signal processing is provided for each output. The sensors may be patched to the control systems through saturating lead-lag compensation networks. The control systems consist of three gas jet systems, four reaction wheel systems, and two array drive systems, where each control system is provided with six possible control laws. Reaction wheel speed control and unloading loops are provided. Author

N68-35641*# Bellcomm, Inc., Washington, D. C.

COVARIANCE FUNCTION OF ELEVATIONS ON A CRATERED PLANETARY SURFACE. PART 2: CRATER RIM AND EJECTA BLANKET CONTRIBUTION

Allan H. Marcus 6 Aug. 1968 31 p refs

(Contract NASw-417)

(NASA-CR-97085; TR-68-340-5, Pt. 2) CFSTI: HC $3.00/MF $0.65 CSCL 03B

We derive the covariance function and power spectral density of elevations on a plane surface which has been excavated by paraboloidal craters with power law exterior rims and inverse power law size distribution. At moderate spatial frequencies the spectral density is an inverse power law with exponent which is a function of the parameters of the cratering process. These functions can be used to predict and/or represent the statistical roughness of surfaces similar to the lunar maria at a scale of several meters. The functions are of direct interest in vehicle mobility analyses and in interpretation of radar power returns. Author

N68-35642*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A PRELIMINARY QUARANTINE ANALYSIS OF A POSSIBLE MARINER VENUS 1972 MISSION

C. W. Craven, E. J. Sherry, and J. A. Stern 15 Apr. 1968 13 p refs

(NAS7-100)

(NASA-CR-97071; JPL-TM-33-377) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Quarantine constraints for the analysis were derived from prior constraints established for earlier planetary missions. A quarantine

allocation model was developed that permits easy test of the probability of contamination from key sources. Concern was mainly directed to the lander capsule, spacecraft, bio-barrier, and various debris as possible sources of contamination. Various mission modes considered included separation or no separation of the planetary vehicle, separation and bias aiming of the spacecraft to avoid impact, and separation but crashing spacecraft. Areas for further investigation have been identified. Author

N68-35685*# United Aircraft Corp., East Hartford, Conn. Research Labs.
STUDY OF TRAJECTORIES AND UPPER STAGE PROPULSION REQUIREMENTS FOR EXPLORATION OF THE SOLAR SYSTEM. VOLUME 1: SUMMARY Final Report
R. V. Ragsac Sep. 1967 41 p refs
(Contract NAS2-2928)
(NASA-CR-73254; F-910352-13, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

User-oriented computer programs were developed for solving selected trajectory and system optimization problems characteristic of low-acceleration, power-limited, constant-thrust (electrically propelled) interplanetary vehicles. Analytical studies included the variational formulation of several heliocentric, power-limited trajectory problems, and the associated payload fraction maximization for a series of interplanetary flight and power modes, including single- or multiple-coast trajectories. The problems of the planetocentric low-acceleration spiral and of thrusting through one gravity field into another are also investigated. Summary data are presented on (1) a set of computer programs which simultaneously optimize both the electric propulsion system parameters and the trajectory thrusting program; (2) a computer program for minimizing the initial gross mass of a vehicle using a combined high-plus-low-acceleration propulsion system; (3) improved convergence properties for the constant thrust, single coast, system trajectory optimization computer program; (4) procedure for optimizing the propulsion parameters of an all-electric vehicle operating both in planetocentric and heliocentric space; and (5) complete sets of variational equations for a series of system-trajectory optimization problems. M.G.J.

N68-35689*# Bellcomm, Inc., Washington, D. C.
DISTRIBUTION OF ELEVATIONS ON A CRATERED PLANETARY SURFACE
Allan H. Marcus 18 Jul. 1968 36 p refs
(Contract NASw-417)
(NASA-CR-97086; TR-68-340-4) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The distribution of elevations on a cratered planetary surface is computed from a theoretical model which assumes the surface is altered only by the formation of crater bowls, rims, and ejecta blankets. The broad inverse power law distribution of crater diameters induces a very broad distribution of elevations with (asymptotic) inverse power law tails which, in some cases, can be explicitly expressed. Typical surface elevations grow at least as fast as the age of the surface, although the volume of fragmental material grows more slowly than the age of the surface. Estimates by Oberbeck and Quaide (1967) of the distribution of the thickness of the fragmental surface layer in Oceanus Procellarum are consistent with the theory. Author

N68-35731*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MASS LOSS FROM CORONAE AND ITS EFFECT UPON STELLAR ROTATION
Kyoji Nariai Sep. 1968 17 p refs Presented at the 2nd Trieste Colloq. on Mass Loss from Stars, Trieste, Italy, 12–14 Sep. 1968
(NASA-TM-X-63352; X-641-68-359) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The acoustic energy generation rate from the convective zone was calculated for various models. Results show that chromosphere and corona can be expected around stars with temperature lower than 8,000 °K at the main sequence, and lower than 6,500 °K at log g = 2. When a star is rotating rapidly, mass loss fro'1m its corona is large, and can be an effective mechanism of braking the stellar rotation. If this mechanism is effective, we can explain the slow rotation of stars later than F2 to be the result of the loss of the angular momentum through a stellar wind that is effective in their main sequence phase. Stars with mass $M > 1.5\ M_{\odot}$ lose mass through a stellar wind during their contraction phase. The mass loss rate is larger than the solar value because of the larger energy input into the chromosphere-corona system and because of the smaller gravitational potential at the surface. T Tauri stars may be the observational counterparts for such stars. As the duration of contraction phase is very short (less than 10^7 years), the braking mechanism works only in the presence of a strong magnetic field (Ap) or in the presence of a companion (Am). Author

N68-35748# Technische Hochschule Munchen (West Germany). Institut fuer Astronomische und Physikalische Geodaesie.
ON THE DYNAMICAL USE OF ORBITS OF ARTIFICIAL SATELLITES [ZUR DYNAMISCHEN NUTZUNG DER BAHNEN KUENSTLICHER SATELLITEN]
M. Schneider Aug. 1968 23 p refs In GERMAN; ENGLISH Summary Sponsored by Bundesministerium fuer wiss. Forsch.
(BMwF-FB-W-68-55; Rept.-53) CFSTI: HC $3.00/MF $0.65

The deviations of the true satellite motion from a reference orbit obey an equation of motion. This problem is written as an integral equation, its solution for given boundary values is eignefunctions. The system of condition equations for the coefficients of this series are used for determining field parameters. An application of the method to the determination of the coefficients of the earth's gravitational potential is given and further possibilities sketched. Author

N68-35765*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPOSITION OF THE LUNAR HIGHLANDS: POSSIBLE IMPLICATIONS FOR EVOLUTION OF THE EARTH'S CRUST
Paul P. Lowman, Jr. Aug. 1968 28 p refs Revised
(NASA-TM-X-63348; X-644-68-320) CFSTI: HC $3.00/MF $0.65 CSCL 03B

This paper is a theoretical investigation of the implications for the origin of continents and ocean basins of three possible chemical compositions for the lunar highlands: ultrabasic, basic, and intermediate to acidic. Ultrabasic or basic lunar highlands would imply that the existence of sialic crust on the earth is due to some major difference between the earth and the moon; the three most likely are presence of an atmosphere, presence of a core, and size. The theory that continents are essentially geosynclinal accretions is shown by recent geological investigations to have numerous weaknesses, and may imply an age for the earth of over 5 billion years. A proposed alternative is that large, thick primordial continents were formed by high-pressure magmatic processes caused by early segregation of the core, with later continental evolution being essentially subordinate accretion to and reworking of these proto-continents. A basic composition for the lunar highlands would imply that the basic crustal layers of the earth are the remnants of a primordial basaltic crust. Sialic lunar highlands would imply that continents are essentially igneous, and derived from the mantle early in geologic time. Author

N68-35784# Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany).
KINETIC AND STOCHASTIC INTERACTION PROCESSES RELATED TO SOLAR PROBE MISSION
H. D. Middendorf Apr. 1968 37 p refs
CFSTI: HC $3.00/MF $0.65

Probe related disturbances and shock wave structure, solar wind and cosmic ray modulation, and particle motion and kinetics in stochastic fields are considered in relation to determining the kinetic and stochastic interaction processes related to a solar probe mission. A large number of individual problems posed by such a mission are considered related to particle and wave interaction processes in plasmas with random inhomogeneities. It is, therefore, recommended that theoretical research activities investigate the free molecular flow pattern and collective interaction processes in the vicinity of the probe, derive a model for charge distribution in the region, and determine the dynamic response for the specified frequency regime. Effect on shock width and shock fine structure or processes typical of solar wind plasma must be determined, and a model of the energetic plasma clouds ejected during flare events must be devised. Small and medium-scale processes should be emphasized in such a solar probe. M.W.R.

N68-35812*# United Aircraft Corp., East Hartford, Conn. Research Labs.

STUDY OF TRAJECTORIES AND UPPER STAGE PROPULSION REQUIREMENTS FOR EXPLORATION OF THE SOLAR SYSTEM. VOLUME 2: TECHNICAL REPORT Final Report, Aug. 1966–Sep. 1967

R. V. Ragsac Sep. 1967 209 p refs

(Contract NAS2-2928)

(NASA-CR-73255; F-910352-13, v. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Computer programs were developed that simultaneously optimized both propulsion system and trajectory for low acceleration, power limited, constant thrust, and electrically propelled interplanetary spacecraft. To optimize heliocentric power-limited trajectories, planet-to-planet rendezvous was treated with an internal discrimination between one or two coast periods, and one-way planetary flybys were included with either one or two coast allowed. Initial mass on earth parking was minimized for a vehicle using combined high and low acceleration propulsion in parking orbit to parking orbit, one-way flyby, and round-trip stopover modes. An improved single coast trajectory program was developed; a numerical analysis was made to determine effects of neglecting low thrust operation within the planetary activity sphere immediately after high thrust burnout; and low thrust spiral departure or capture was studied. A theoretical study of the motion of the low thrust vehicle as it moves between a planetary gravity field and the solar field was performed to account for planetary perturbations in performance calculations. Aids for analyzing constant thrust systems were developed, as was a system of variational equations for system-trajectory optimization problems. M.W.R.

N68-35847*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

MARINER MARS 1964 PROJECT REPORT: TELEVISION EXPERIMENT. PART 1: INVESTIGATOR'S REPORT. MARINER 4 PICTURES OF MARS

Robert B. Leighton (Calif. Inst. of Tech.), Bruce C. Murray (Calif. Inst. of Tech.), Robert P. Sharp (Calif. Inst. of Tech.), J. Denton Allen, and Richard K. Sloan 15 Dec. 1967 194 p refs

(Contract NAS7-100)

(NASA-CR-97078; JPL-TR-32-884, Pt. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Reduced data obtained from the Mariner IV television experiment are presented in numerical and pictorial form. Procedures are described for correcting the original digital data for (1) intensity and spectral transfer characteristics of the camera system; (2) geometric distortions introduced by nonlinear effects in the TV line scan; (3) modulation transfer function of the camera; and (4) scattered light. Design, construction, calibration, and operation of the television subsystem are described. The calibrated and sharpened pictures are presented in several forms convenient for study. Surface features tentatively identified, or possibly identifiable, with previously mapped markings include Propontis I, one or more "canals", and the boundary between the light area Mesogaea and the dark area Mare Sirenum near Titanum Sinus. K.W.

N68-35850*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

MINIMUM FUEL CONTROL OF A PITCH MOTION OF A SATELLITE IN CIRCULAR ORBIT

Frank J. Rees and I. Fluegge-Lotz Aug. 1968 222 p refs

(Grant NsG 133)

(NASA-CR-97076; SUDAAR-352) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Finding the minimum effort control for a particular satellite attitude motion where the pitch motion may be described by the nonlinear equation $\ddot{x}(t) + \sin x(t) = u(t)$ $|u| \leq A$, $A > 1$ is the subject of this study. For reaction jet controllers, the minimum effort criterion corresponds to minimum fuel expenditure. Pontryagin's maximum principle is used to obtain the necessary conditions on the control u(t) for a fuel-optimal trajectory. The backwards time formulation is presented and possible control sequences are enumerated. The backwards time adjoint variables are found as functions of the state variables and initial conditions, and the pseudoextremals of the maximum principle are related to the characteristic canonical equations of Hamilton–Jacobi. Switching loci are derived. The linear problem is compared with the nonlinear, and an indication is given of the large region for which the linearized solution predicts the nonlinear system performance with good accuracy. An efficient suboptimal design is proposed and evaluated. K.W.

N68-35902*# United Aircraft Corp., East Hartford, Conn. Research Labs.

A SURVEY OF IMPULSIVE TRAJECTORIES Final Report

F. W. Gobetz and J. R. Doll Jun. 1968 124 p refs

(Contract NAS8-21091)

(NASA-CR-61999; G-910557-11) CFSTI: HC $3.00/MF $0.65 CSCL 22C

An extensive survey of astrodynamics problems in which thrust periods are simulated by impulses was made. Basic objectives were to produce a coherent picture of the state-of-the-art in this field and to isolate problem areas in which future research should be applied. Impulsive trajectories were categorized into three major groupings: intercept, transfer, and rendezvous. It was concluded: (1) The subject of fixed-time trajectories, as applied to specific problems in intercept, transfer, and rendezvous, has received insufficient attention in the literature. (2) Optimal multi-impulse trajectories should be investigated for application in each of the major trajectory categories. (3) Optimal, time-fixed rendezvous is a subject for which the solution of basic problems would be beneficial to many priority space flight applications. Author

N68-35944# RCA Service Co., Inc., Camden, N. J.

DIGITAL AND HYBRID SIMULATION OF AN ORBITAL AND REENTRY VEHICLE Final Report, Jun. 1965–Feb. 1967

William M. Ruhsam and John W. Kiowski May 1968 147 p refs

(Contract AF 33(615)-2930)

(AMRL-TR-67-139; AD-673517)

The report documents research on techniques and components that may be used to efficiently simulate an orbital and reentry vehicle with a digital or a hybrid computer system. A mathematical model based on a Gemini-type spacecraft is defined. The spacecraft model was simulated with three separate programs: (1) A digital program running at a single iteration rate for all parts of the simulation. (2) A digital program that operates with four concurrent iteration rates. Each iteration rate is associated with a grouping of the functions of the spacecraft model having similar frequencies. The higher frequency groups operate with the faster iteration rates.

(3) A hybrid program that simulated the spacecraft with digital and analog equipment. Four photoresitive 8 common product multipliers were constructed to increase the computation capabilities of analog equipment. A study of techniques of function generation and program debugging is presented. The question of floating point versus fixed point programming for simulation is discussed. Author (TAB)

N68-35950# Aerospace Corp., El Segundo, Calif. El Segundo Technical Operations.
ON THE IRRADIANCE FROM STARS IN THE INFRARED
Milton Ritter Mar. 1968 36 p refs
(Contract F04695-67-C-0158)
(TR-0158(3525-29)-2; SAMSO-TR-68-253; AD-672759)

Observational data are given on the infrared irradiance from stars. These data and certain criteria, postulated herein, enable a prediction of the number of stars that yield spectral irradiances (to 22 microns) which equal or exceed indicated levels. Establishment of credible growth rates of the number of stars with stellar magnitude, in the infrared, constitutes the critical element of the prediction technique. The prediction is speculative. It should be closer to reality, however, than current predictions based on spectral extrapolation from the visual components of the radiation of stars. Author (TAB)

N68-36002# Pan American World Airways, Inc., Patrick AFB, Fla. Aerospace Services Div.
THE EFFECT OF UNMOLDED ERRORS ON ORBITAL ESTIMATION
Norman Bush AF Eastern Test Range Mar. 1968 41 p refs
(ETV-TM-68-86-TM-89; AFETR-TR-68-9; AD-673880)

One of the major problems in orbital estimation is to realistically obtain an estimate of the accuracy of the orbit trajectory and other parameters, such as instrumentation biases and survey. Some of the uncontrollable (i.e. unmodeled) factors that contribute to the total uncertainty are survey uncertainties of the tracking stations, uncertainties in the geopotential constants and drag uncertainty. A statistical technique is described that performs a variance propagation so as to obtain accuracy estimates based on random error plus unmodeled effects. This variance propagation then yields realistic accuracy estimates of all adjustable parameters. An example of the unmodeled error propagation is shown for the Geos B satellite. In this case accuracy of instrumentation biases and survey were of the most importance. Author (TAB)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-34955 Ohio State Univ., Columbus.
GRAVITY GRADIENT EFFECTS ON SOME OF THE BASIC STABILITY REQUIREMENTS FOR AN ORBITING SATELLITE HAVING LONG FLEXIBLE ANTENNAE
James Clarence Kennedy, Jr. (Ph.D. Thesis) 1967 113 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-16294

The equations of motion for an orbiting satellite having long flexible antennae and under the influence of the earth's gravity gradient torque are formulated in order to study the effects of elastic deformations and gravity gradient on the basic stability requirements of the system. The gravity torque on a satellite of arbitrary shape is developed assuming a spherical earth as the main attracting body. A stability analysis is conducted for two typical rigid spacecraft configurations. Also, the gravity torque on the satellite of arbitrary shape is developed assuming an oblate earth model as the main attracting body. Thus, the oblateness contribution to gravity torque is established. The equations of rotational motion and the equations which represent the flexible motions of the antennae are derived using the Newtonion formulation. Stability boundaries which indicate functional relationships between structural parameters and orbital and attitude parameters are established. Dissert. Abstr.

N68-35021# Defence Research Telecommunications Establishment, Ottawa (Ontario).
[DEFENCE RESEARCH TELECOMMUNICATIONS ESTABLISHMENT] Annual Report, 1967
P. A. Field, comp. Jun. 1968 81 p refs
(DRTE-1195-U) CFSTI: HC $3.00/MF $0.65

Summaries of work are presented on the following: (1) satellite programs, including Alouette 1 and 2, Isis A and B, the Topside project, rocket experiments, and satellite communications; (2) high frequency processes and rocket experiments in the ionosphere; (3) solid state physics research in germanium, calcium salt, and liquid lasers; (4) microelectronics, basic circuitry, and computer-aided electronics design; (5) laboratory studies in air traffic control radar, electrical noise interference aboard ships, arctic communications, ice and soil research, and high altitude aircraft tracking; (6) computing center activities; and (7) various subsidiary projects in electronics, physics, electronic parts and materials, microwave components, and semiconductor devices. K.W.

N68-35022*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FIRST U.S. MANNED SIX-PASS ORBITAL MISSION (MERCURY-ATLAS 8, SPACECRAFT 16)
John H. Boynton, ed. Washington Sep. 1968 225 p refs
(NASA-TN-D-5807) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The results and analyses of the third U.S. manned orbital mission are presented. The mission was accomplished October 3, 1962, as a phase of Project Mercury. Spacecraft and launch-vehicle descriptions, mission operations, and postflight analyses are included. Particular treatment is given to the investigations of spacecraft systems performance and aeromedical analyses of the pilot. Author

N68-35185# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
EFFECT OF THE NEAR-EARTH ENVIRONMENT ON THE ATTITUDE OF A SLOWLY SPINNING MULTIBODY SATELLITE (X-RAY EXPLORER)
D. K. Anand, J. M. Whisnant, and M. Sturmanis Jul. 1968 35 p refs
(Contract NOw-62-0604)
(APL-TG-1010; AD-673219)

This paper considers the effects of the near-earth environment on the dynamics of a slowly spinning satellite (1/12 rpm). A rotor is employed to obtain the necessary angular momentum parallel to the spin axis. The satellite has four solar paddles and an eddy current nutation damper. The objective of the satellite is to detect and chart X-ray emitting sources in the celestial sphere. The dynamics of the spacecraft are investigated by numerically integrating the nonlinear equations of motion which include external perturbations. The effects of the magnetic, gravity-gradient, and solar environments on the attitude are small. However, the effect of aerodynamic torques is seen to be significant. Variations in spin rate and spin axis drift are obtained for different atmospheric conditions and physical parameters. Also, the pointing error to the precession axis referred to a fixed star is established. Author (TAB)

N68-35204# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
DYNAMICAL ANALYSIS OF A THREE-BODY GRAVITY-GRADIENT SPACECRAFT
J. M. Whisnant and V. L. Pisacane May 1968 44 p refs
(Contract NOw-62-0604-c)
(APL-TG-1005; AD-673218)

This paper gives the results of a dynamical analysis of the in-orbit-plane motion of a three-body spacecraft. The linearized differential equations of motion and characteristic determinant are developed for gravity-gradient stabilization with passive damping of librational energy. Two damping techniques are considered: one depends on relative motion between the component bodies of the spacecraft, the other on the relative motion between the spacecraft and an ambient magnetic field. The general results are applied to an artificial earth satellite consisting of two rigid bodies connected by a cable which is several miles long. With only viscous damping at the cable pivots, it is demonstrated that an undamped libration mode exists unless the two rigid bodies have triaxial ellipsoids of inertia. Furthermore, the time constants of the motion are inadequate even for unrealistically large mass distributions. The second damping technique considered gives more favorable results. Acceptable transient performance is obtained by dissipating energy viscously through the geomagnetic field. In addition, triaxial inertia ellipsoids of the two end bodies are not required. Author (TAB)

N68-35231*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A LIGHTWEIGHT 6 1/2-FT AEROSHELL FOR AN EARLY MARS PROBE MISSION
R. G. Nagler, R. A. Boundy, J. R. Scholl (Rohr Corp.), and J. B. Dawson (Rohr Corp.) 15 Sep. 1968 54 p refs
(Contract NAS7-100)
(NASA-CR-96994; JPL-TR-32-1325) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Mars provides new challenges in the design of survivable atmospheric probes. This report analyzes the problems of and presents a design concept for meeting those challenges. A lightweight, 6 1/2-ft-diam, sphere-cone, honeycomb-sandwich structure with an elastomeric ablator is described which is almost an order-of-magnitude lighter per unit area than those in the manned space program, allowing atmospheric deceleration at densities equivalent to very high altitudes on earth. This structure is made primarily from phenolic glass fiber for ease of fabrication and rf transparency, but titanium rings are used as stiffeners at the outer edge. Details of the fabrication are delineated, and the results of supplementary studies to prove structural reliability and environmental compatibility are given. This type of structure is easily fabricated under normal shop practices. Experience with constructing two of the 6 1/2-ft-diam aeroshells indicates that lightweight, 20-ft-diam (or larger) aeroshells can be fabricated to reasonably close tolerances. Author

N68-35254*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR 6 MISSION REPORT. PART 1: MISSION DESCRIPTION AND PERFORMANCE
15 Sep. 1968 237 p refs
(Contract NAS7-100)
(NASA-CR-96992; JPL-TR-32-1262) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Surveyor 6, the sixth in a series of seven unmanned spacecraft designed to soft-land on the moon and return engineering and scientific data, was launched from Cape Kennedy, Florida, on November 7, 1967. All established objectives for the mission were achieved. After a nominal lunar transit phase, a successful soft landing was accomplished on November 10, 1967, in the Central Bay at 0.47 deg north latitude and 1.38 deg west longitude. Surveyor 6 performed extensive operations before shutdown after sunset of the first lunar day and also was operated briefly the second lunar day. A large quantity of television pictures were provided from the relatively level mare surface on which the spacecraft landed. Other information was also obtained, including data on the chemical composition of the moon provided by an alpha scattering instrument. Unique results were obtained on this mission from a postlanding spacecraft hop experiment, in which the spacecraft moved 8 ft over the lunar surface, and an attitude gas jet firing which caused detectable erosion of the lunar surface. Author

N68-35357*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE EVALUATION OF ATLAS-CENTAUR RESTART CAPABILITY IN EARTH ORBIT
Washington Sep. 1968 213 p refs
(NASA-TM-X-1647) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The flight of Atlas-Centaur launch vehicle AC-9 on October 26, 1966 was the final flight in the Centaur research and development program. The vehicle carried a mass model of the Surveyor spacecraft. The mass model was boosted into a simulated lunar intercept trajectory using a parking-orbit mode of ascent. This mode of ascent placed the Centaur in a circular orbit. After coasting under low-gravity conditions, the Centaur main engines were restarted to supply energy to attain the proper simulated lunar intercept trajectory. This report includes a flight performance evaluation of the Atlas-Centaur systems for the total launch vehicle mission. Author

N68-35427# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SYNCHRONOUS SATELLITE STATIONKEEPING SIMULATION
M. Chandler Crocker and Ellen H. Swenson May 1968 116 p refs
(Contract AF 19(628)-5167)
(ESD-TR-68-87; TN-1968-10; AD-672980)

A program has been written to simulate the east-west stationkeeping of a synchronous satellite. Different ways of implementing the thrust sequence of rocket motors and solar sails are discussed. Author (TAB)

N68-35514 Measurement Analysis Corp., Los Angeles, Calif.
A METHOD FOR PREDICTING LAUNCH VEHICLE VIBRATION LEVELS IN THE REGION OF THE SPACECRAFT ADAPTOR
A. G. Piersol and W. F. van der Laan Jun. 1968 104 p refs
(MAC-709-10)

A set of prediction curves is derived for launch vehicle vibration levels in the region of the spacecraft adaptor structure. The prediction curves are derived through a regression analysis of previous data collected for various different launch vehicle configurations, and are based upon six rudimentary parameters describing the launch vehicle flight and propulsion conditions. The intent is to provide a basis for making preliminary vibration predictions early in the conceptual design of a new launch vehicle configuration so that test specifications and design criteria can be established for the procurement of long lead time equipment. The predictions are presented in terms of average power spectral densities in octave band frequency intervals for liftoff, transonic flight, and maximum dynamic pressure flight. The efficiency of the curves is fully evaluated. Author

N68-35600*# Volt Information Sciences, Inc., Washington, D. C.
THE AUTOMATIC STATION "ZOND-5" FLEW AROUND THE MOON AND RETURNED TO EARTH
A. Dmitriyev Goddard Space Flight Center, Greenbelt, Md. NASA 30 Sep. 1968 8 p Transl. into ENGLISH from Pravda (Moscow), no. 269, 25 Sep. 1968
(Contract NAS5-12487)
(NASA-CR-97016; ST-PR-LPS-10759) CSCL 22B

This is the first article of its kind, describing the launching of ZOND-5, its apparatus, the various maneuvers over the trajectory to, past the Moon and return to Earth. Apparatus is briefly described and the conditions for accurate hitting of the soft landing spot are amply discussed. Author

N68-35622*# Honeywell, Inc., Minneapolis, Minn. Aerospace Div.
SATURN 5/VOYAGER LOAD RELIEF STUDY Final Report
L. D. Edinger, T. W. Hughes, and J. Lehfeldt 25 Mar. 1968 113 p refs
(Contract NAS8-21171)
(NASA-CR-61956; Rept.-21171-FR) CFSTI: HC $3.00/MF $0.65 CSCL 22D

A load relief control system, designated LR-2, was developed to improve the launch probability of the Saturn V booster with the Voyager payload. This LR-2 system functions as an attitude control system during the first and last portions of the flight and as a load relief system during the time of high dynamic pressure in the middle of the flight. Designed to be used in both pitch and yaw axes during the first-stage flight, the LR-2 has four feedbacks consisting of attitude and attitude rate for attitude control, body normal acceleration for load relief, and drift rate to assure acceptable terminal condition performance. Performance of the control system is summarized; and the control problem is discussed in terms of the vehicle model, requirements, and constraints. An analysis was made of the Saturn V/Apollo system modified to provide a load relief capability, and the load relief system that used a platform-mounted accelerometer is described. Frequency response plots and root locus plots are presented, along with analog and digital computer trajectory runs and the synthesis procedure used to define feedback compensation in the LR-2 system. M.W.R.

N68-35707# Entwicklungsring Sud, Munich (West Germany).
RECOVERABLE SOUNDING ROCKET. RIGID WINGS SYSTEM [RUECKFUEHRBARE HOEHENFORSCHUNG-SRAKETE. VERSION STARRFLUEGLER]
W. Schnaebele Jul. 1968 65 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer wiss. Forsch.
(BMwF-FB-W-68-44) CFSTI: HC $3.00/MF $0.65

This sounding rocket concept is designed to meet requirements for operation over populated areas. The analysis covers user's specifications, payload, peak altitude, safety, and reusability. Features of the design are extendable rigid wings, homing device for locating landing site, a remote control system, solid fuel propulsion, parachute for soft landing, and capability for optical launch from ground or aircraft. Wind tunnel tests, free-flight experiments, design of the homing instrumentation, and reliability studies are described. K.W.

N68-35771*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CYLINDRICAL ELECTROSTATIC PROBES EMPLOYED ON ALOUETTE 2 AND EXPLORER 31 SATELLITES
J. A. Findlay and L. H. Brace Jul. 1968 21 p refs
(NASA-TM-X-63344; X-623-68-281) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The Cylindrical Electrostatic Probe experiment, employed on both the Alouette 2 and the Explorer 31 satellites, provided a common denominator for inter-satellite comparisons of directly measured parameters. The instruments used identical sensors, but differences in satellites resulted in some differences in data formats and experiment potentials. There was considerable interference from the topside sounder seen on the probe data from Alouette II which made data processing difficult, though not impossible. Author

N68-35815*# Bellcomm, Inc., Washington, D. C.
DESIGN PARAMETERS FOR AN ORBITING TOPSIDE SOUNDER FOR MARS AND VENUS AND SOME COMPARISONS WITH THE ORBITING OCCULTATION EXPERIMENT
W. R. Sill 30 Jul. 1968 41 p refs
(Contract NASw-417)
(NASA-CR-97087; TR-68-710-5) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The design parameters for a Venus and Mars topside sounder are discussed and compared to those for the earth orbiting Alouette topside sounders. Author

N68-35954*# Volt Information Sciences, Inc., Washington, D. C.
HAVING FLOWN AROUND THE MOON, THE AUTOMATIC STATION "ZOND-5" SUCCESSFULLY RETURNED TO EARTH WITH SECOND COSMIC VELOCITY
Goddard Space Flight Center, Greenbelt, Md. NASA 26 Sep. 1968 3 p Transl. into ENGLISH from Pravda (Moscow), 23 Sep. 1968
(Contract NAS5-12487)
(NASA-CR-97014; ST-PR-LPS-10758) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A Tass communique reviews the general accomplishments of the Zond 5 lunar probe, which was launched September 15, 1968. After a seven-day flight that included a flight around the moon and accumulation of scientific information of the space surrounding the moon, the space station returned to earth with second cosmic velocity. Some comments by Soviet scientists note the great accomplishments of this space mission. M.W.R.

N68-35980*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MARS HARD LANDER CAPSULE STUDY. VOLUME 1: SUMMARY Final Report
31 Jul. 1968 246 p
(Contract NAS1-8098)
(NASA-CR-66678-1; Doc.-68SD952-1, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22

Broad range parametric data are summarized; six point designs were prepared to verify the accuracy of these data. The point designs consist of three pairs with similar landed capabilities; one capsule of each pair is designed for out-of-orbit entry subsequent to separation from spacecraft in Mars orbit, the other for direct entry from interplanetary transfer trajectory. The system requirements for each design are tabulated, and the constraints they impose on the supporting orbiter are defined. Reference missions and a reference science subsystem are also defined. A 1973 out-of-orbit entry mission and a hard lander capsule (point design 7), containing ≈ 50 lb. of scientific instrumentation, is suggested from study results. It is concluded that scientific payloads of approximately 1500 pounds (to fit in a 10 ft launch vehicle shroud) can be placed on the Mars surface, survive for several months, and transmit more than a hundred million bits of data to earth. Additional data show that a smaller capsule of 700 to 900 pounds has the ability to transmit approximately 10 million bits of imagery, meteorological, and planet surface data. B.P.

N68-35981*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MARS HARD LANDER CAPSULE STUDY. VOLUME 2: MISSION AND SCIENCE DEFINITION Final Report
31 Jul. 1968 347 p refs
(Contract NAS1-8098)
(NASA-CR-66678-2; Doc.-68SD952-2, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Mission objectives and constraints for the 1973 Orbiter/Lander project were built upon data from successfully completed Mariner

4 Mars fly-by mission, NASA specifications, and particular atmospheric and geophysical models of Mars. Using these guidelines an analysis was performed to define out-of-orbit entry and direct entry reference missions. Data to aid in the analysis included: path angle, downrange dispersions, relay communications with period errors, arrival and deorbit configurations, and sun-earth declination and view times in 1974. The scientific requirements were then translated into instrument selections, and the mission profile during which these measurements would be made was defined. Anticipated accuracies were determined, based on the characteristics and environmental surroundings of these instruments. Consideration was given to the parametric aspects of the science package (e.g., influence of entry conditions on required entry science sampling rates, effect of camera boom height on desired photographic quality vs resultant installation weight), and the detailed instrument requirements as they influence the point designs. B.P.

N68-35982*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MARS HARD LANDER CAPSULE STUDY. VOLUME 3: CAPSULE PARAMETRIC STUDY, BOOK 1 Final Report
31 Jul. 1968 456 p refs
(Contract NAS1-8098)
(NASA-CR-66678-3; Doc.-68SD952-3, V. 3, Bk. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Parametric information (from assumed Mars models and reference missions) is provided for design evaluation and performance estimates of ballistic entry capsules with conventional parachute configurations, as well as lifting, inflatable afterbodies, and extendable flap aeroshell applications to the direct entry mode. These data are presented as mission lander maps which synthesize subsystem data and final results in a format which provides performance estimates of capability for parametric trade-offs for various capsule concepts. Nine retardation blocks, four lander blocks, and five landed subsystem blocks summarize these results; six maps are considered, which contain the six point designs. Variations in point design from the data are investigated for magnitude and cause. Design and development of entry aeroshell and retardation subsystem are based on optimum trade-offs. An aluminum or stainless steel honeycomb structure, combined with an elastomeric heat shield, is recommended for the aeroshell. The parachute retardation subsystem design is an application of demonstrated technology. B.P.

N68-35983*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MARS HARD LANDER CAPSULE STUDY. VOLUME 3: CAPSULE PARAMETRIC STUDY, BOOK 2 Final Report
31 Jul. 1968 554 p refs
(Contract NAS1-8098)
(NASA-CR-66678-4; Doc.-68SD952-4, V. 3, Bk. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A parametric analysis of the Mars hard lander subsystem included data on science parameters, photoimaging, telecommunications, electrical power and distribution, environmental control, and impact attenuation and structure. Deorbit propulsion, attitude control parameters, and canister/adapter parameters were considered in the evaluation of the reentry subsystems. Descriptions are presented on some of the major computer programs used in the thermodynamics, configuration selection, and recovery system selection analyses. Also included are the analyses of the loads acting on the canister separation joint and the tip-off imparted to the capsule as a result of separation from the orbiter. B.P.

N68-35984*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MARS HARD LANDER CAPSULE STUDY. VOLUME 4: CAPSULE POINT DESIGNS AND SUPPORTING ANALYSIS, BOOK 1 Final Report
31 Jul. 1968 514 p refs
(Contract NAS1-8098)
(NASA-CR-66678-5; Doc.-68SD952-5, V. 4, Bk. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The principal design and performance characteristics of the various Mars hard lander point designs studied are summarized. The designs are in pairs that conduct the same entry and science experiments and have the same surface lifetime. One capsule of each pair is designed for out-of-orbit entry, the other for direct entry from the interplanetary trajectory. Design criteria and mission constraints are detailed for the first capsule pair (designated point designs 1 and 2) which has a surface lifetime of one diurnal cycle, a data requirement of 10^7 bits surface imagery and meteorological data (relayed via a synchronous orbiter), and a minimum science package. Two versions of point design 2 (direct entry, one diurnal cycle, minimum science capsule) were examined to demonstrate the influence of omni- versus multi-impact capability. B.P.

N68-35985*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MARS HARD LANDER CAPSULE STUDY. VOLUME 4: CAPSULE POINT DESIGNS AND SUPPORTING ANALYSIS, BOOK 2 Final Report
31 Jul. 1968 515 p refs
(Contract NAS1-8098)
(NASA-CR-66678-6; Doc.-68SD952-6, V. 4, Bk. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Analytical design data are given for the second capsule pair (point designs 3 and 4). This pair model is designed for a surface lifetime of 90 days or more and includes the minimum science subsystem. The data acquired during entry are relayed to the orbiter and the surface imagery data are transmitted, real time, to the orbiter after impact and again at periapsis passage. The lander of each capsule is equipped for direct transmission of data to the Goldstone Station. After the third day of this Mars mission concept, the orbiter ephemeris is changed to conduct a mapping mission and the lander radio relay link is discontinued. The meteorological data acquired thereafter are transmitted directly to earth. The lander is designed with a 25 ft^2 solar array/battery regenerative power system for data transmission on both direct and relay links, and with equipment to receive earth commands. B.P.

N68-35986*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MARS HARD LANDER CAPSULE STUDY. VOLUME 4: CAPSULE POINT DESIGNS AND SUPPORTING ANALYSIS, BOOK 3 Final Report
31 Jul. 1968 585 p refs
(Contract NAS1-8098)
(NASA-CR-66678-7; Doc.-68SD952-7, V. 4, Bk. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Engineering design criteria were developed for the third Mars hard lander capsule pair. Point designs 5 and 6 have a surface lifetime of 90 days or more and contain a relay link to the orbiter, a direct link to earth, and a command link to control lander operations from earth. The solar array/battery regenerative power system is increased to 45 ft^2 to provide the additional power required to accommodate the expanded science subsystem, and obtain imagery data toward the end of the mission. Conceptual layout drawings illustrate two means of increasing payload size (decelerator load), for direct entry at entry flight path angles of about $\gamma_e = 40°$, and ballistic coefficients 5.5 psf (0.17 slug/ft^2). The two means were the use of lift applied to a 60° sphere-cone, and an increase in drag through the use of Airmat applied in an inflatable cone frustrum. B.P.

N68-35987*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MARS HARD LANDER CAPSULE STUDY. VOLUME 4: CAPSULE POINT DESIGNS AND SUPPORTING ANALYSIS, BOOK 4 Final Report
31 Jul. 1968 238 p refs
(Contract NAS1-8098)
(NASA-CR-66678-8; Doc.-68SD952-8, V. 4, Bk. 4) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Supporting data are presented to document the various analyses conducted on the Mars hard landing system. These include: (1) two effects of impact attenuation and structural criteria on the capsule point design as they apply to gross vehicle dynamic response, and individual scientific component isolation and response; (2) Martian surface conditions, impact velocity, and kinematical requirements; (3) effects on the point designs due to variation in assumed design parameters (probability of variation occurrence is assumed to be exceedingly small); (4) probable design, mission, and system aspects of the Mariner Mars '73 orbiter system, and its constraints. B.P.

N68-36003 National Lending Library for Science and Technology, Boston Spa (England).
SOVIET LUNAR SPACECRAFT
A. Vinogradov and Yu. Lipskii 5 Sep. 1968 9 p Transl. into ENGLISH from Pravda (Moscow), 12 Apr. 1968
(RAE-LIB-TRANS-115) Available from Natl. Lending Library, Boston Spa, Engl.

A brief outline of successful Soviet lunar spacecraft, their missions, and their accomplishments is presented starting with Lunik 1 and ending with Lunik 14. The emphasis, however, is on the accomplishments of Lunik 10, 11, 12, and 14. The data obtained by these spacecraft on lunar composition, structure, mass, temperature, and atmosphere are mentioned. K.W.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-34845 Northwestern Univ., Evanston, Ill.
POST-BUCKLING BEHAVIOR OF ELASTIC FRAMES
Francisco Santiago Manuel (Ph.D. Thesis) 1967 123 p
Available from Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-15284

The analysis of large deflections of piecewise prismatic, rectilinear frames subjected to arbitrary discrete loads and boundary conditions is presented. By solving the exact nonlinear differential equation of bending for each of the segments between load points, points of discontinuity in curvature and/or inflection points, recurrence equations for the coordinates and the arc distance from the origin of all the station points of the structure are established. A second set of recurrence equations for the internal forces at all the station points are obtained from the equilibrium conditions for each of these segments. These two sets of equations along with the prescribed boundary conditions constitute the complete system of equations, the solution of which defines completely the equilibrium configuration of the frame under the prescribed loads. A computer program written in the FORTRAN language was used for solving most of these examples. Examples illustrating the analysis of the stability and post-buckling behavior of frames which exhibit either a snap-through or a bifurcation type of instability are also included. Dissert. Abstr.

N68-34857 Illinois Univ., Urbana.
AN APPLICATION OF SCATTERED LIGHT PHOTOELASTICITY TO DYNAMIC STRESS ANALYSIS
John Henry Hemann (Ph.D. Thesis) 1967 57 p
Available from Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-11863

This thesis presents an experimental investigation of a three-dimensional dynamic stress analysis problem using scattered light photoelasticity. The light source is a ruby laser which has a light pulse of 0.175 microseconds duration. The stress waves are effectively stopped photographically with the 0.175 microsecond light pulse. The laser has sufficient intensity so that dynamic scattered light fringe photographs are obtainable even though only a small percentage of the light is scattered. The problem investigated is a semi-infinite space, experimentally represented by a large solid cylinder, with a dynamic point load applied at the top surface. The dynamic point load is created by a small explosive charge. The differences in principal stresses are found along a line directly below the load point. Dissert. Abstr.

N68-34859 Florida Univ., Gainesville.
MOIRE METHOD APPLIED TO THE STUDY OF DYNAMIC RESPONSE OF VISCOELASTIC MATERIAL WITH LARGE DEFORMATION
Fu-pen Chiang (Ph.D. Thesis) 1966 168 p
Available from Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 67-12916

Developments in the basic theory of the moiré method as well as the extension of its applications are presented in this research. The technique of using rotational mismatch to increase the accuracy of the moiré method was introduced. While the linear mismatch only increases the accuracy of obtaining direct derivatives, the use of rotational mismatch increases the accuracy of obtaining cross derivatives. Two methods of making linearly mismatched master grids were also developed. The moiré phenomenon of two grids superimposed with a gap in between was examined in detail. A gap equation was derived analytically and proved experimentally. The application of the moiré method was extended to solving dynamic problems in viscoelasticity with large deformation. The problem of a viscoelastic solid propellant ring reinforced by a Fiberglas casing under suddenly applied internal pressure was studied. Dissert. Abstr.

N68-34865 New Mexico State Univ., University Park.
FINITE TRANSFORM SOLUTION OF THE ELASTICALLY RESTRAINED, DAMPED AND ARBITRARILY LOADED BEAM
George Robert Sharp, Jr. (Ph.D. Thesis) 1967 78 p
Available from Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-12849

The problem of lateral vibration of an elastically restrained beam which is damped and arbitrarily loaded is solved by means of a finite transform. The derivation of the transform is based on the properties of a self-adjoint operator and its orthogonal basis vectors. The solution is a linear combination of the basis vectors and assumes one of three forms depending on the damping constant. Two numerical examples, both undamped, are considered: 1) a beam acted on by a uniform load over part of the span and by a concentrated load; 2) a beam subjected to a distributed impulse and to a concentrated impulse. A short table of the eigenfunctions, eigenvalues, and normal functions, all of which are functions of the end restraints, is appended. Dissert. Abstr.

N68-34879 Lehigh Univ., Bethlehem, Pa.
THE PROPAGATION OF PLASTIC STRAIN PULSES IN LEAD BARS
James Howard Shea (Ph.D. Thesis) 1967 113 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-14954

The behavior of an elastic-plastic deformation pulse produced in a cylindrical lead bar by reflection of an air shock from one end has been studied by measuring the time variation of stress as well as strain and displacement at several locations along the length of the bar. Observations were made during the approximately 600 microseconds before the pressure decreased on the loaded end. Specimens were one inch in diameter and of sufficient length that there was no interference due to a reflection from the unloaded end. Longitudinal stress was measured by inserting an X-cut quartz transducer between sections of the bar. Radial strains were determined by circumferentially wound resistance gauges. The displacement was observed by attaching one end of an advance wire to a point on the bar and noting the resistance change in the wire as it was stretched. To determine whether reasonable predictions of the observed behavior could be made from a knowledge only of the properties of the material and the known boundary and initial conditions, computer solutions giving stress, strain, and displacement as a function of position and time were generated using one-dimensional equations of various degrees of complexity. Dissert. Abstr.

N68-34890 Arizona Univ., Tucson.
INFINITESIMAL DEFORMATION SUPERPOSED ON A FINITE DEFORMATION OF AN ALMOST INCOMPRESSIBLE ELASTIC SOLID
Ronald Reed Miller (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-12181

In the solution of problems concerned with finite deformations of elastic solids, the assumption of incompressibility usually leads to considerable simplication, and the majority of solutions which have been obtained are for incompressible materials. A brief review of the theory of finite deformations appears in this paper along with solutions of two problems dealing with incompressible materials: the simultaneous extension, torsion and inflation of a circular cylindrical tube and the inflation of a thick spherical shell. Dissert. Abstr.

N68-34893 Northwestern Univ., Evanston, Ill.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF TRANSIENT WAVE PROPAGATION IN A COMPOSITE HALF-SPACE
Farrokh Nozer Scrawvala (Ph.D. Thesis) 1967 120 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-15336

The propagation of transient waves in a composite elastic half-space consisting of two elastic quarter-spaces welded on the sides of a thin semi-infinite sheet is studied, both analytically and experimentally. In the analytical investigation the free edge of the sheet is subjected to a time dependent load. An approximate analytical approach is based on the assumption that the sheet is so thin that transverse displacements can be neglected, i.e., thickness stretch motion of the sheet is ignored. Wave propagation in the composite half-space is studied experimentally by using the technique of dynamic photoelasticity. A composite plate consisting of a square plexiglas rod with plates of HYSOL 4485 glued on two sides is used to obtain the fringe patterns in the HYSOL plates generated by dropping a weight on the rod. Dissert. Abstr.

N68-34901 Texas Univ., Austin.
STRESS AND STRAIN IN RIGHT CIRCULAR CYLINDERS ROTATING ABOUT A TRANSVERSE AXIS: A BOUNDARY PROBLEM IN LINEAR ELASTICITY
John Milton Vance (Ph.D. Thesis) 1967 217 p
Available from Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 67-14895

Determination of stress and strain in solid and hollow circular cylinders of a homogeneous, isotropic, elastic material rotating about a transverse axis is considered. The axis of rotation may be located either through the centroid or exterior to the cylinder. In either case the axis of rotation must pass through the axis of the cylinder. In the latter case the end of the cylinder nearest the axis of rotation is assumed to remain plane. A useful analytical solution is obtained for solid cylinders as the sum of solutions to plane strain stress field and an axisymmetric stress field. The latter field is determined in the form of infinite series derived from a stress function. A similar solution for hollow cylinders is valid only for an exterior axis of rotation located so that the predominant stress field is axisymmetric. The solutions for both solid and hollow cylinders are also applicable to the determination of stress and strain induced in cylinders hanging vertically in a gravity field from a built-in end. Dissert. Abstr.

N68-34958 Purdue Univ., Lafayette, Ind.
AN EXPERIMENTAL INVESTIGATION OF NONLINEAR ISOTHERMAL VISCOELASTICITY
William Goldberg (Ph.D. Thesis) 1967 217 p
Available from Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 67-18639

The research contained in this thesis is essentially divided into two main parts. In the first part, the behavior of isotropic, incompressible simple materials in stress relaxation is examined. It is shown that the results of a series of combined torsion-tension stress relaxation experiments provide sufficient information to characterize completely the behavior of such materials under arbitrary stress relaxation loading conditions. A rapid deformation approximation based on the notion of time-temperature superposition and the latter theory is presented. It is also shown that this approximation has a form which is identical to one developed using a rapid deformation constitutive theory proposed by Leigh. The second part of this thesis is devoted to the experimental investigation. Dissert. Abstr.

N68-34962 Columbia Univ., New York.
STUDIES ON THE TRANSMISSION OF STRESS WAVES THROUGH STRATIFIED MEDIA
Alvin Levy (Ph.D. Thesis) 1966 99 p
Available from Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-5792

Two distinct but related problems are investigated, dealing with the propagation of stress-waves through a system of layers. The first is concerned with liquid-saturated porous layers separating similarly-constituted half-spaces, all interfaces being plane and parallel. The second has to do with a system of layers bounded by half-spaces, each being impermeable and elastic, but here the interfaces are corrugated rather than plane. Reflection and transmission coefficients are computed in each case for normally incident disturbances, and these are examined in detail for the technically important cases of small pore size and small boundary irregularities, respectively. Dissert. Abstr.

N68-34967 National Lending Library for Science and Technology, Boston Spa (England).
REVIEW OF SOVIET WORKS ON CREEP CALCULATIONS OF MACHINE COMPONENTS
N. N. Malinen Aug. 1968 63 p refs Transl. into ENGLISH from Mashinostr. (Kiev), no. 11, 1965 p 229-277 (RTS-4610) Available from Natl. Lending Library, Boston Spa, Engl: 40s

Creep hypotheses and methods of calculating creep in machine components in the Soviet Union are reviewed through 1963. Theories of aging, flow, and hardening were found to have widest application in mechanical engineering; and attention is given to the plastic heredity theory used in concrete and ferroconcrete structures. Specific topics reviewed are creep under a constant tensile load, creep theories and their experimental verification, and rupture life. Creep under non-uniaxial stress conditions is considered in terms

of both plasticity theory and rupture life; and conditions of stress and strain of construction components under creep conditions are reviewed. The latter includes methods of solving steady and unsteady creep problems for beams and beam systems, thick-walled tubes and disks, and plates and shells. Stress concentration, contact problems, and time to failure of construction members are also treated. M.W.R.

N68-35028 California Univ., Berkeley.
ON NONLINEAR VIBRATIONS OF A PARTICLE IN A PLANE
Ta-lun Yang (Ph.D. Thesis) 1967 89 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-11680

The equipotential curves, the existence and stability of "similar" normal-mode free vibrations and of forced steady-state vibrations are examined to study the effect of kinematic nonlinearities. If the spring force is a strictly monotone function of the length change, the equipotential curves are shown to have either one or three singular points, depending on the initial stress in the springs, or the system has one or three equilibrium positions. For a system having linear springs, it is shown that only two straight modal lines exist. The solutions for similar normal-mode free vibrations and for forced steady-state vibrations of finite amplitudes are formally obtained. The stability of the solutions is investigated by studying the Mathieu equations, obtained from the first variations of the equations of motion. The initial stress in the springs turns out to be an important parameter in the stability analysis. The solutions are frequently unstable even when this stress is tensile. Dissert. Abstr.

N68-35030 Northwestern Univ., Evanston, Ill.
STUDIES IN VISCOELASTIC WAVE PROPAGATION
Ronald Mitchell Wolosewick (Ph.D. Thesis) 1967 118 p
Available from Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-15373

Two problems in the area of linear viscoelasticity are examined. The first problem concerns transient longitudinal wave propagation in a one-dimensional and semi-infinite rod. The constitutive equation for this material is based on a molecular model for polymethylmethacrylate. Laplace transforms are used to eliminate the time dependence. The inversion of the transformed quantities yields a series of integrals that must be evaluated by numerical methods. The solutions can be extended to other polymeric materials. The resulting stresses are presented for the case of a step and sinusoidal stress input. These results show that the wave front moves at a constant velocity independent of the temperature. The space attenuation of the progressive wave on the other hand is highly temperature dependent. The second problem concerns the higher modes in steady time harmonic axi-symmetric torsional wave propagation. The effects of the temperature and rod diameter on the resulting shear stresses and tangential displacement are considered. The results indicate that the space attenuation coefficient K_{ij} is the governing factor in the solution for the tangential displacement and the two shear stresses $\sigma_r\theta$ and $\sigma\theta_z$. In particular when the zero mode attenuation coefficient, k_{i0}, is two orders of magnitude smaller than the higher mode attenuation coefficients, the solutions for V, $\sigma_{r\theta}$ and $\sigma\theta z$ are a linear function of the radius for $z/a \leq 1$ and $a \leq 10$ cm. Graphical results for V, $\sigma_{r\theta}$ and $\sigma_{\theta z}$ are presented. Dissert. Abstr.

N68-35048 Northwestern Univ., Evanston, Ill.
ELASTIC PLASTIC ANALYSIS OF GRID SYSTEMS
Tongchat Hongladaromp (Ph.D. Thesis) 1967 143 p
Available from Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-15245

A method for analyzing the piecewise linear behavior of elastic-plastic grid systems is presented. The method of analysis bridges the gap between elastic analysis and limit analysis, and provides the complete load-deflection history of grid systems starting from the elastic regime, through all the piecewise linear regimes characterized by the successive formation of plastic hinges and terminating the collapse regime. The equilibrium and compatibility equations are written in terms of the bending moments, and plastic hinge rotations, the load parameters and an elastic-plastic transition function. The use of this transition function allows the formulation to be applicable to any of the piecewise linear regimes. A technique of linear scaling within each regime is employed to determine the points of transition between consecutive regimes, the last transition point defining the state of incipient plastic collapse. Dissert. Abstr.

N68-35057 Case Inst. of Tech., Cleveland, Ohio.
ERROR ANALYSIS FOR ELASTIC THIN SHELLS
John Garrison, Jr. (Ph.D. Thesis) 1967 177 p
Available from Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 67-16073

The problems of small deformation of shells of revolution for symmetric and asymmetric loadings are formulated in terms of a singular perturbation problem. Extensive use is made of vector–matrix methods, and the techniques of asymptotic integration for single ordinary differential equations are generalized for the case of a system of equations. Error estimates are obtained for the error incurred in the solution to the boundary value problem by neglecting terms in the system of equations. Error estimates are also obtained for the difference between the solution to the boundary value problem and approximate solutions which are solutions to related boundary value problems. Dissert. Abstr.

N68-35058 Cornell Univ., Ithaca, N. Y.
THREE PROBLEMS OF SMALL ELASTIC DEFORMATIONS SUPERIMPOSED ON THE FINITE ELASTIC DEFORMATION OF A CIRCULAR CYLINDER
Daniel Harry Watt (Ph.D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-16377

Three problems are solved using the theory of small deformations superimposed upon the finite deformation of an elastic body. In this approach, an arbitrary small deformation is added to a known exact solution to a problem in the theory of finite elastic deformations. By considering terms of first order of smallness in the small deformation parameter, and neglecting all terms of second order or higher, a linearized set of perturbed equations of motion is obtained, which must be satisfied by the additional small displacements. Together with a similarly derived set of perturbed boundary conditions, these equations constitute a linear boundary value problem. The first problem is based on an exact solution for the finite deformation of a rotating circular cylinder. The second problem is based on an exact solution for the finite extension of a circular cylinder of a Mooney material. The third problem is based on an exact solution for the finite extension and torsion of a cylinder of a neo–Hookean material. Dissert. Abstr.

N68-35071*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ULTRASONIC DETECTION AND MEASUREMENT OF FATIGUE CRACKS IN NOTCHED SPECIMENS
Stanley J. Klima and John C. Freche Washington Sep. 1968 31 p refs To be Presented at the SESA Fall Meeting, San Francisco, 28 Oct.–1 Nov. 1968
(NASA-TN-D-4782) CFSTI: HC $3.00/MF $0.65 CSCL 13H

An ultrasonic technique was developed and used to observe the formation and growth of fatigue cracks in notched cylindrical specimens subjected to reversed axial fatigue loading. Fatigue curves showing cycles to initially detectable cracks as well as cycles to fracture were obtained for an aluminum-, a titanium-, and a cobalt-base alloy and for a maraging steel. Depth of initial

detectable cracks ranged between approximately 0.0005 and 0.004 in. (0.013 and 0.10 mm). Also obtained were curves relating ultrasonic system output voltage to crack depths up to 0.030 in. (0.76 mm) for three materials. These curves were used to demonstrate the capability of the device for monitoring crack growth. Author

N68-35079# Drexel Inst. of Tech., Philadelphia, Pa. Dept. of Mechanical Engineering.
INTRODUCTION TO WAVE PROPAGATION IN COMPOSITE MATERIALS
P. C. Chou Wright-Patterson AFB, Ohio AF Mater. Lab. May 1968 37 p refs
(Contract AF 33(615)-3430)
(AFML-TR-67-427; AD-672269)

The dynamic elasticity equations for isotropic material together with their variations and different simplifications are presented. The basic concepts in wave propagation, especially those concerned with wave velocity, phase velocity, dispersion, and vibration analysis, are discussed. Dispersion equations for a composite two-layered cylindrical shell are derived. The application of the method of characteristics to the two-layered equations are also presented. Author (TAB)

N68-35182# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TOUGH ENEMIES AGAINST THE STRENGTH OF AIRCRAFT, FATIGUE AND CREEP OF METALS
Jen Tso 30 Aug. 1967 9 p Transl. into ENGLISH from Hang K'Ung Chih Shih (Chinese People's Republic), v. 2, no. 10, 1965 p 14–15
(FTD-HT-67-289; AD-673253)

The author discusses metal fatigue and plastic deformation and the effect they have on aircraft parts. The causes of metal fatigue and plastic deformation, the aircraft parts they affect, and preventive measures are considered in the article. Author (TAB)

N68-35198*# California Inst. of Tech., Pasadena.
BUCKLING OF CONICAL SHELLS UNDER AXIAL COMPRESSION
Johann Arbocz Washington NASA Sep. 1968 60 p refs
(Grant NsG-18-59)
(NASA-CR-1162) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An experimental investigation of the effect of the cone semivertex angle on the buckling load of a conical shell under axial compression was carried out. The effect of a specific type of initial imperfection was also investigated. The imperfection studied was axially symmetric in shape. The experiments were carried out with shells fabricated by a copper electroforming process. The shells had no longitudinal seams. Final results showed that the dependence of the buckling load on the semivertex angle is adequately represented by the linearized theory. Also the upper boundary to the experimental results of the cones with known axisymmetric initial imperfections agreed well with previously published analytical values. Author

N68-35199*# California Inst. of Tech., Pasadena.
EXPERIMENTAL INVESTIGATION OF THE EFFECT OF GENERAL IMPERFECTIONS ON THE BUCKLING OF CYLINDRICAL SHELLS
Johann Arbocz and C. D. Babcock, Jr. Washington NASA Sep. 1968 81 p refs
(Grant NsG-18-59)
(NASA-CR-1163) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Results are presented on complete imperfection surveys carried out on cylindrical shells before and during the loading process up to the buckling load. A noncontact probe was used to make these surveys on electroformed copper shells. The data recording process was fully automatized and the data reduction was done on an IBM 7094. Three-dimensional plots were obtained of the measured initial imperfection surfaces and of the growth of these imperfections under increasing axial loading. The modal components of the measured imperfection surfaces were also obtained. Preliminary results indicated that the prebuckling deformation which apparently caused the reduction in buckling load from that of a perfect shell could not be represented by an isolated mode. Author

N68-35205# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
TEMPERATURE AND THERMAL STRESS PROBLEMS OF THIN-WALLED SPHERES AND CONES WITH AERODYNAMIC HEATING Research Report
Szu Hsiung Chu, S. V. Nardo, and M. A. Goldberg Jul. 1968 140 p refs
(Contract Nonr-839(23))
(PIBAL-68-21; AD-673005)

A number of exact and approximate solutions are presented for the axisymmetrical temperature distribution and thermal stresses in thin spherical, conical and spherically-blunted shells. In the heat conduction analysis, the thermal input is assumed to be in the form of aerodynamic heating. Spherical shell and truncated cone problems with various boundary conditions are solved; also presented are solutions involving a combination of these shell elements, namely, a spherically-blunted cone. Thermal stress solutions are obtained for the foregoing problems. The governing equations assume no coupling between the thermal and elastic fields. J. W. Geckeler's assumptions are used to get the approximate solutions for hemispherical, conical, and combined shell configurations. Both simply-supported and fixed-edge boundary conditions are considered. Author (TAB)

N68-35223# Brown Univ., Providence, R. I. Div. of Engineering.
NOTCH BRITTLENESS AFTER PRESTRAINING, PART 3 Final Technical Report
C. Mylonas and S. Kobayashi Jun. 1968 56 p refs
(Contracts NObs-88294; ARPA SD-86)
(NYO-2394-32; ARPA-E45, Pt. 3; TR-7; AD-673089)

Notched plates and bars prestrained in compression or extension, before or after notching, at 70F or 550F were tested to fracture in tension at -16F. It was found that a catastrophic reduction of ductility could be caused by small prestrains. Uniform longitudinal or transverse prestraining by as little as 0.05 at 70F reduced the initial ductility of notched bars by a factor of 4 or more. Hot prestraining was even more damaging: the greatest drop in the ductility at -16F was caused by prestrains of only 0.025 at 550F. These tests indicate that the brittle behavior of mild steel structures results from some damaging prior history of straining. Accordingly the proper selection of steels should be based on their resistance to embrittlement by suitable straining rather than on their properties in the initial undamaged state. The presented testing methods offer a great control over the steel ductility. They would be useful both in steel assessment and in the investigations of the factors influencing the resistance of steel to fracture. Author (TAB)

N68-35237# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL DETERMINATION OF RESIDUAL STRESSES IN WINDING UNIDIRECTIONAL GLASS-FIBER-REINFORCED PLASTICS [EKSPERIMENTALNOE OPREDELENIE OSTATOCHNYKH NAPRYAZHENII PRI NAMOTKE ODNONAPRAVLENNYKH STEKLOPLASTIKOV]
R. E. Brivmanis 12 Sep. 1967 16 p refs Transl. into ENGLISH from Mekhan. Polimerov USSR), no. 1, 1966 p 123–129
(FTD-HT-67-268; AD-672909)

Results of experimental research on residual stresses in prestressed systems wound in the form of rings on one-directional

glass strips are given. The dependence of residual stress values on the tension applied to a strip in winding was derived. The primary tension of a glass strip in the main stages of fabrication of an article was shown. Test results on the rupture of freely wound rings are given. Author (TAB)

N68-35303# California Univ., Berkeley. Div. of Applied Mechanics.
LARGE DEFORMATION SOLUTIONS FOR AN ELASTIC COSSERAT SURFACE
P. M. Naghdi and M. J. Crochet Jun. 1968 58 p refs
(Contract Nonr-222(69))
(AM-68-5; AD-672918)

A discussion is given of a class of static and dynamic solutions for finite isothermal deformation of an elastic Cosserat surface. The constitutive equations used are those for a Cosserat surface with holohedral isotropy. In all cases considered, the displacement gradients and the director displacements are assumed to be independent of surface coordinates. The solutions mainly concern problems associated with cylindrical and spherical surfaces. Author (TAB)

N68-35330# California Univ., Berkeley. Div. of Applied Mechanics.
DETERMINATION OF THE CONSTITUTIVE COEFFICIENTS FOR A MIXTURE OF TWO SOLIDS
T. R. Steel May 1968 27 p refs
(Contract Nonr-222(69))
(AM-68-4; AD-672917)

Using a theory of mixtures allowing different temperatures for each constituent, we first discuss non-linear constitutive equations for a mixture of two elastic solids. Then, upon specialization, we determine relations between certain of the material constants related to each constituent and the corresponding constants related to the mixture. We linearize the constitutive equations by assuming that all displacements from the undeformed state, and all subsequent temperature changes, are small and we further show how to evaluate the constants appearing in the linearized constitutive equations, under certain assumptions which are shown to be thermodynamically consistent. Author (TAB)

N68-35331# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
CLOSED-FORM SOLUTIONS TO PROBLEMS OF WAVE PROPAGATION IN A RIGID, WORKHARDENING, LOCKING ROD
R. C. Shieh, G. A. Hegemier, and W. Prager Jul. 1968 26 p refs
(Contract DASA01-68-C-0017)
(DASA-2101-1; AD-672569)

One-dimensional wave propagation in s semi-finite, rigid, workhardening, locking rod is considered. The general problem is discussed and closed-form solutions are obtained for several special cases. It is anticipated that the latter will provide useful check-cases for numerical programs designed to cope with wave propagation in media with complex constitutive laws. The stipulated mechanical behavior is also interesting in its own right since it is qualitatively typical of soils in uniaxial compressive strain. Author (TAB)

N68-35359#
STABILITY OF ORTHOTROPIC SHELLS OF REVOLUTION SUBJECTED TO AXISYMMETRIC LOADINGS
V. I. Miachenkov [1967] 10 p refs Transl. into ENGLISH from Inzh. Zh., Mekh. Tverdogo Tela (USSR), no. 1, 1968 p 106–113
CFSTI: HC $3.00/MF $0.65

The problem of stability of orthotropic shells of revolution having an axisymmetric initial imperfection is considered. It is assumed that the stress state of the shell prior to buckling is a moment state, and described by nonlinear relationships. A system of two differential equations with any combination of boundary conditions is reduced to a system of homogeneous linear algebraic equations whose matrix has a normal nine diagonal structure. An algorithm is proposed for the calculation of the least eigenvalue of the system. Author

N68-35395# State Univ. of New York at Buffalo. Div. of Interdisciplinary Studies and Research.
DIFFRACTION OF A PLANE ACOUSTIC PULSE BY A FREE ORTHOGONAL TRIHEDRON (3-D CORNER)
R. P. Shaw and D. F. Courtine May 1968 45 p refs
(Contract Nonr-4449(00); Grant NSF GP-56-75)
(Rept.-32; AD-673002)

The normal velocity field on arbitrary three dimensional scattering surfaces, struck by a weak acoustic plane wave is considered. Numerical solutions for a right angle wedge and a right angle corner (i.e., three orthogonal edges of infinite length) are found. For the wedge, the angle between the wave front normal and the wedge edge may be arbitrary, while for the corner the wave front normal is taken to form equal angles with the three orthogonal edges to make use of symmetry. In both problems, the scattering obstacle is assumed to have a free surface (i.e., pressure is zero). The wedge problem, for which an exact solution is known, is used as a test case for the various numerical procedures used. Author (TAB)

N68-35411# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
SOME THEOREMS IN CLASSICAL ELASTODYNAMICS
Lewis T. Wheeler and Eli Sternberg Jul. 1968 86 p refs
(Contract NONr-220(58))
(TR-15; AD-672566)

The investigation is concerned with various fundamental aspects of the linearized dynamical theory for mechanically homogeneous and isotropic elastic solids. First, the uniqueness and reciprocal theorems of dynamic elasticity are extended to unbounded domains with the aid of a generalized energy identity and a lemma on the prolonged quiescence of the far field, which are established for this purpose. Next, the basic singular solutions of elastodynamics are studied and used to generate systematically love's integral identity for the displacement field. As well as an associated identity for the field of stress. These results, in conjunction with suitably defined Green's functions, are applied to the construction of integral representations for the solution of the first and second boundary-initial value problem. Finally, a uniqueness theorem in dynamic concentrated-load problems is obtained. Author (TAB)

N68-35432# State Univ. of New York at Buffalo. Div. of Interdisciplinary Studies and Research.
WAVE FRONT STRESS RELAXATION IN A ONE-DIMENSIONAL NONLINEAR INELASTIC MATERIAL WITH TEMPERATURE AND POSITION DEPENDENT PROPERTIES
R. F. Shaw and F. Cozzarelli Jul. 1968 22 p refs
(Contract Nonr-4449(00))
(Rept.-34; AD-673003)

Analytical solutions are obtained for stress, velocity and strain at the wave front in a suddenly loaded semi-infinite rod of a material with a linear instantaneous response and nonlinear inelastic response. The material properties are assumed to depend on position directly or through a dependence on a prescribed nonuniform temperature field. Detailed solutions are obtained for two examples - a nonlinear viscoelastic material with temperature dependent parameters and a rate-sensitive plastic material which may have temperature dependent parameters and yield point. Author (TAB)

N68-35484# Columbia Univ., New York. Lubrication Research Lab.

IMPROVED FREE EDGE CONDITIONS FOR THE DIFFERENTIAL EQUATION OF A FLAT PLATE SUBJECTED TO ANTISYMMETRICAL, SPACE-VARIABLE NORMAL LOADING ON ITS FACES

H. G. Elrod and Des R. Sood Jul. 1968 71p refs
(Contract Nonr-4259(14))
(TR-12; AD-672572)

In a previous report, a differential equation was derived for the pseudo mid-plane displacement of a flat plate subjected to antisymmetrical, space-variable normal stresses on its exposed faces. The true mid-plane displacement and various other quantities of interest, like stresses, stress resultants and couples and displacements, are derivable from the pseudo mid-plane displacement by differential operations. The asymptotic theory of Friedrichs and Dressler is implemented to provide improved boundary conditions for the case of a free edge correct to O(H)sq. Generalized expressions for the stress distribution, valid uniformly from the plate interior through the transition region to the free edge, are obtained. Author (TAB)

N68-35485# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

RAYLEIGH-LAMB WAVE PROPAGATION IN ANISOTROPIC MEDIA

Charles David Mosbruger (M.S. Thesis) Jun. 1968 85 p refs
(GSF/MC/68-6; AD-672972)

The stiffness matrix relating stress to strain in the generalized Hookes Law can, for anisotropic materials, be written in terms of the isotropic matrix plus a set of perturbation terms. This matrix and the Rayleigh-Lamb displacement field are used to determine special forms of the equilibrium equations for anisotropic Rayleigh-Lamb waves. The forms of anisotropy were restricted to the hexagonal, orthorhombic, cubic, and tetragonal crystal classes, and a frequency equation which is an anisotropic analog to the equation published by Lamb in 1917 was developed for these materials. Perturbation effects on the frequency equations were then examined. Author (TAB)

N68-35488# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.

LARGE DEFLECTION AND STABILITY ANALYSIS OF TWO DIMENSIONAL TRUSS AND FRAME STRUCTURES

David M. Purdy and John S. Przemieniecki May 1968 64 p refs Presented at Interm. Symp. on Space Technol. and Sci. no. 7, Tokyo, 15–20 May 1967
(AFFDL-TR-68-38; AD-672816)

Frame structures with either pinned or fixed joints are frequently used in aerospace applications as the primary structure supporting light secondary panels or other structural assemblies. In the analysis of such structural designs it is very often necessary to consider loading conditions for which the deflections are large enough to cause significant changes in the geometry of the structure so that the equations of equilibrium must be formulated for the deformed configuration. In the present paper the general analysis for large deflections of frame structures is presented using the concept of discrete element idealization. The solution for deflections and stresses is presented as a step-by-step matrix method based on load increments and is particularly suitable for computer programming. As a bi-product of the large deflection analysis the eigenvalue equations for structural stability are also formulated. The theoretical results of the nonlinear, large deflection matrix solution are compared with the exact analytical results for a square frame. In addition, the results for deflections of a six-bay truss and buckling of columns with either constant axial load or gravity loading are also presented. The computer program listing and instructions for the preparation of input data are included. Author (TAB)

N68-35496*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DIVERGENCE OF SOME ALL-MOVABLE CONTROL SURFACES INCLUDING DRAG LOADING

Robert C. Goetz Washington Oct. 1968 13 p refs
(NASA-TN-D-4793) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The aeroelastic divergence characteristics of some rigid all-movable control surfaces supported by a flexible shaft have been studied analytically, and the results have been compared with existing experimental data in the Mach number range from 1.64 to 15.4. The configuration studied was a blunt, double-wedge control surface supported by a long, thin cantilever that was weak in the lift direction and stiff in the drag direction. The results of the study indicate that a new type of divergence instability is inherent to this configuration. Its character is a mode of deflection consisting of lateral bending accompanied by torsional rotation. The analysis and experiments indicate that drag loadings, in addition to lift loadings, are important in this new divergence instability. Estimates obtained from a potential energy analysis using aerodynamic characteristics calculated from simple Newtonian theory were in fair agreement with the experimental results over the entire Mach number range; however, excellent agreement resulted when measured static aerodynamic derivatives were incorporated into the analysis for the Mach 6.8 and 15.4 experiments. Author

N68-35502# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugzeugbau.

CONTRIBUTION TO THE CALCULATION OF THE BUCKLING LOADS OF PLATE STRIPS WITH HEAT STRESSES VARIABLE ACROSS THE WIDTH OF THE PLATE [BEITRAG ZUR BERECHNUNG DER BEULLASTEN VON PLATTENSTREIFEN MIT UEBER DIE STREIFENBREITE VERAENDERLICHEN WAERMESPANNUNGEN]

Karl-Heinz Knoepke 3 May 1968 31 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-33) CFSTI: HC $3.00/MF $0.65

The partial differential equation governing the buckling of an infinitely long orthotropic plate due to longitudinal stresses varying across the width of the plate, is converted into an ordinary differential equation by assuming the buckling pattern to be sinusoidal in the longitudinal strips each of which has constant stresses. Thus the continous stress distribution in the lateral direction is transformed into a step function, and from the original differential equation with variable coefficients a number of differential equations with constant coefficients is obtained. These equations are solved by means of Laplace's transformation, and the solutions are combined to the final solution by the method of transfer matrices. The procedure was programmed for a digital computer. Some results of computations are given. Author

N68-35558 National Lending Library for Science and Technology, Boston Spa (England).

THE INFLUENCE OF FOG ICE DEPOSITS ON AERIAL SUPPORTS

H. Anders [1968] 14 p refs Transl. into ENGLISH from Tech. Mitt. Rfz. (Ger.), v. 12, no. 1, 1968 p 13–18
(TRANS-2487) Available from Natl. Lending Library, Boston Spa, Engl.

A discussion of some factors affecting the loading of aerial supports which are exposed to fog ice is held here, which are of interest for example to the stressmen and which are intended to be taken into account in the revision of TGL 13480 "steel aerial supports". Author

N68-35562 National Lending Library for Science and Technology, Boston Spa (England).

ATTACHMENT TO PENDULUM-TYPE IMPACT TESTING HAMMERS FOR THE DETERMINATION OF THE LOAD-TIME

RELATIONSHIP [ZARIZENI K ZJISTOVANI ZAVISLOSTI SILA-CAS PRI RAZOVYCH ZKOUSKACH NA KYVADLOVYCH KLADIVECH]
M. Holzmann and J. Man 25 Jul. 1968 20 p refs Transl. into ENGLISH from Strojirenstvi (Prague), v. 16, no. 8, Aug. 1966 p 614–619
(SMRE-TRANS-5450) Available from Natl. Lending Library, Boston Spa, Engl.

An essentially simple method is described for the modification of the usual pendulum-type hammer used in impact tests for the determination of the load–time relationship. In spite of a certain complexity of the evaluation of the results, the suggested modification is very expedient since it is inexpensive and can be carried out by the laboratory personnel themselves. Author

N68-35609#
ON THE FREEZING OF DEFORMATIONS IN THE PHOTOELASTICITY METHOD
E. I. Edel'shtein [1967] 11 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 7, 1968 p 118–127
CFSTI: HC $3.00/MF $0.65

Deformational properties of polymers are studied by using a "freezing" model based on the theory of highly elastic strain stresses. The investigated material is loaded by constant surface forces and heated to a temperature characteristic for this material. This model is then slowly cooled to room temperature without load reduction and the linear dependence between the stresses, strains, and path differences are determined by optical quantities. Qualitative analysis of the deformation process shows that the operators governing the stresses and strains can be represented as linear combinations for the fixed stress-strain state under constant effective forces and that the path differences which take place at highly elastic strain temperatures remain in the model after unloading to a certain degree. The fixed path difference is determined primarily by strains occuring at the characteristic temperature and as such remains "frozen". G.G.

N68-35610#
PHOTOMETRIC DETERMINATION OF THE FRACTIONAL FRINGE ORDERS IN A POLARIZATION OPTICS INVESTIGATION OF THE STRESS STATE
Iu. S. Rudnitskii [1967] 3 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR, Ser. A, Fiz.-Tekh. i Mat. Nauk (Kiev), no. 6, 1968 p 556–558
CFSTI: HC $3.00/MF $0.65

Proposed is a photometric method to determine quantitatively stress field changes acting on a disk loaded by forces of different magnitude along its diameter. The negative image of the disk fringe map on photographic film is evaluated for changes in light ray intensity and principal stress differences at a certain point through galvanometric readings and the results are plotted on graphs for evaluation. G.G.

N68-35632*# General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. STRUCTURAL DYNAMICS MODEL TESTING
J. W. Wissmann Washington NASA Sep. 1968 48 p refs
(Contract NAS8-11486)
(NASA-CR-1195) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The principles of realistic modeling are outlined in terms of dimensional analysis, and similitude and scaling laws which introduce a physical configuration for the prototype along with the one for the scale model. Mathematical representations for each are given. Scale factors sufficient for most routine model work are calculated, and the requirements for kinematic similitude and dynamic similitude are formulated. The practical advantages of distorted scale models are cited, and the mathematical representations are reformulated to account for the variables. An example is included to demonstrate how the analytical formulation of a problem can be used to advantage to design an experiment, to reduce the number of independent variables, and to account for model distortions. Consideration is also given to ways of treating scale effects which represent a special case of model distortions. Recommended test practices are identified as definition of the problem, justification of the use of models, assessment of the model design parameters, model engineering, test setup, test procedure, and data evaluation and interpretation. M.G.J.

N68-35640# Technische Hogeschool, Delft (Netherlands). Afdeling der Werktuigbouwkunde.
NONLINEAR VIBRATIONS IN VEHICLE ENGINEERING
A. D. de Pater Apr. 1968 22 p refs Presented at the 4th Conf. on Nonlinear Oscillations, Prague, Sep. 1967
(WTHD-4) CFSTI: HC $3.00/MF $0.65

Various vehicular engineering problems in the area of nonlinear vibrations were reviewed, including the behavior of a vehicle moving with constant speed over an uneven pavement with sinusoidal shape. Other aspects considered are the contact between a wheel and a pavement or a rail, the shimmy phenomenon of road vehicles, and the hunting movement of railway vehicles. For the last, differential equations are given which govern the motion of a simple vehicle with two degrees of freedom, movement along a straight track is considered, and the special case of a track with small lateral sinusoidal deviations is treated. M.W.R.

N68-35681# Oak Ridge National Lab., Tenn.
ATTENUATION OF SHOCK WAVES IN LONG PIPES BY ORIFICE PLATES, ROUGH WALLS, AND CYLINDRICAL OBSTACLES
Lawrence Dresner and Conrad V. Chester Jul. 1968 36 p refs
(Contract W-7405-eng-26; ARPA Order 907)
(ORNL-4288) CFSTI: HC $3.00/MF $0.65

Exploratory measurements of the attenuation of shock waves in tubes by orifice plates, rough walls, and cylindrical obstacles are reported. The measurements were carried out in a four-inch shock tube driven by an explosive mixture of propane and oxygen. It appears possible to correlate the attenuation produced by obstacles placed in the flow with their Fanning friction factors. The orifice plates and cylindrical obstacles are very efficient attenuators. Author (NSA)

N68-35737*# Techtran Corp., Glen Burnie, Md.
INVESTIGATIONS OF CRATERS BY MICROPROJECTILES AT A VELOCITY RANGE OF 0.5 TO 10 km/SECOND
Volker Rudolph Washington NASA Sep. 1968 50 p refs Transl. into ENGLISH of the dissertation "Untersuchungen an Kratern von Mikroprojektilen im Geschwindigkeitsbereich von 0.5 bis 10 km/sec." Heidelberg, Ruprecht-Karl-Unive., 1967 p 1–46
(Contract NASw-1695)
(NASA-TT-F-11890) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Tests were performed to determine the shape, diameter, and depth of craters produced in Pb, Cd, Ag, Cu, and Al target materials by impact of artificially accelerated Fe—projectiles of μ-size of velocities ranging from 0.5 to 10 km/second. Formulas are derived to approximate the relationships between projectile mass, diameter, and velocity, and diameter, depth, and volume of the craters produced. The results are compared with corresponding relationships developed in earlier research for cm-size projectiles to derive similarity equations in first approximation. Author

N68-35790# Technische Hogeschule, Delft (Netherlands). Dept. of Mechanical Engineering.
ON THE THERMODYNAMIC BACKGROUND OF ELASTIC STABILITY THEORY
W. T. Koiter Jun. 1968 15 p refs
(WTHD-NR-7; Rept.-360) CFSTI: HC $3.00/MF $0.65

Elastic stability is usually discussed from a strictly mechanical point of view. The elastic potential is introduced in this approach as the basic postulate of material behavior. In the present paper it is postulated that the internal energy per unit mass is specified by the entropy per unit mass as a single thermodynamic variable, in addition to the deformation. The deformation is described by the symmetric strain tensor, and the internal energy depends on the strain components, and possibly on the strain gradients, as well as on the specific entropy. The equation of energy balance and the second law of thermodynamics then lead in a natural way to an energy criterion as a both necessary and sufficient condition for stability of an equilibrium configuration. It is of interest to observe that the elastic energy in this criterion is specified by the free thermodynamic energy at the constant temperature of the equilibrium configuration, even in most cases of a thermally isolated surface of the elastic body. Loss of stability therefore appears as an isothermal phenomenon, in contrast to the widely held belief that buckling as a rapid phenomenon would represent an adiabatic process. Author

N68-35817# Technische Hogeschool, Delft (Netherlands). Afdeling der Werktuigbouwkunde.

FOUNDATIONS AND BASIC EQUATIONS OF SHELL THEORY A Survey of Recent Progress

W. T. Koiter Apr. 1968 17 p refs Presented at the 2d IUTAM Symp. on the Theory of Thin Shells, Copenhagen, 5–9 Sep. 1967 (WTHD-5; Rept.-381) CFSTI: HC$3.00/MF$0.65

A discussion of progress in the past ten years, both with reference to the foundations of shell theory and to the resulting basic equations is presented. The foundations have been strengthened in two ways. Several investigators have explored a possible justification of the classical shell equations as a first approximation of asymptotic character. Other investigations aim at concrete estimates of the errors involved in shell theory, starting from the three-dimensional theory of elasticity. Both approaches can claim a considerable measure of success. Some open questions at the time of writing this paper, are discussed. Many attempts have been made at a simplification of the basic equations without loss in accuracy. Such simplifications have already been known for a long time for spherical shells. Considerable success has now also been achieved for circular cylindrical shells, and some progress has also been made for more general shell shapes. Author

N68-35926# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STABILITY AND OSCILLATIONS OF RECTANGULAR SANDWICH PLATES WITH LARGE CUTOUTS [USTOICHIVOST I KOLEBANIYA PRYANOUGOLNYKH TREKHSLOINYKH PLASTIN S BOLSHIMI VYREZAMI]

G. P. Zinenko 14 Sep. 1967 12 p refs Transl. into ENGLISH from Prikl. Mekh., Akad. Nauk Ukr. RSR (Kiev), v. 2, no. 8, 1966 p 59–63 (FTD-HT-67-343; AD-675798)

The report discusses an analysis of data concerning the buckling and free vibration of sandwich plates of symmetrical structure with isotropic face layers and light isotropic cores. It is assumed that the Kirchhoff–Love hypothesis is valid for the faces, and that the tangential displacements vary linearly over the core thickness. A system of partial differential equations for buckling and a system for free vibration are each reduced to a pair of equations by introducing two displacement functions. Author (TAB)

N68-35927# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TRANSCRITICAL DEFORMATION OF A CYLINDRICAL SHELL ON IMPACT [ZAKRITICHESKAYA DEFORMATSIYA TSILINDRICHESKOI OBOLOCHKI PRI UDARE]

V. I. Borisenko and A. I. Klokova 18 Sep. 1967 13 p refs Transl. into ENGLISH from Prikl. Mekh., Akad Nauk Ukr. RSR (Kiev), v. 2, no. 10, 1966 p 29–35 (FTD-HT-67-345; AD-673799)

The axisymmetrical elastic deformation of a circular cylindrical shell under longitudinal impact is investigated by using a system of nonlinear equations with the propagation of elastic stress waves taken into account, and without any assumptions concerning the mode of buckling. One end of the shell is fixed, the other end is axially impacted by a rigid solid moving at a velocity V; the ratio m of the mass of the body to the mass of the shell is given. The analysis of the impact-deformation process in this shell is reduced to solving this nonlinear system with initial and boundary conditions by the method of finite differences, utilizing an explicit scheme whose convergence and stability was checked. The behavior of the shell was studied in the time interval in which the longitudinal compression wave propagates along the whole length of the shell, and the first reflected wave comes back. The results from calculating the normal displacements along the shell at various instants of both waves propagating, for the ratio $m = 3.64$ and nondimensional velocities $V/a = 0.0005$; 0.001; 0.002; and 0.004 (where a is the velocity of sound) are shown in diagrams and are examined. TAB

N68-35988#

STRESS-STRAIN DEPENDENCE IN THE INITIAL PLASTIC DEFORMATION STAGE UNDER BIAXIAL TENSION

I. A. Kozlov, A. A. Lebedev, and V. L. Akhrmenko [1967] 3 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 13, no. 12, 1967 p 118–121 CFSTI: HC$3.00/MF$0.65

Stress state of thin-walled tubular steel samples subjected to biaxial tension in the small plastic deformation domain was measured by resistance strain gauges, taking into account change in the transverse strain coefficient. Noticeable difference between tension and strain diagrams were found; and the difference between relative elongation and strain intensity reached 20%. It is, therefore, concluded that it is not always possible to assume agreement between strain diagram and the curve obtained for tension in computations beyond the elastic limit. When the change in transverse strain coefficient on the initial plastic deformation portion is accounted for, good agreement between experimental and theoretical strain diagrams results. M.W.R.

N68-36007 National Lending Library for Science and Technology, Boston Spa (England).

CONTRIBUTION TO THE OPTIMAL DIMENSIONING OF HYDROSTATICALLY LOADED TANKS WITH PLANE WALLS

E. Merz and G. Vogt [1968] 13 p refs Transl. into ENGLISH from Konstruktion (W. Berlin), no. 18, 1966 p 237–241 (M-7389) Available from Natl. Lending Library, Boston Spa, Engl.

Optimum design diagrams prepared for storage tanks for liquids permit the determination of the maximum allowable width of the tank plate as well as the height when the width and thickness of the plate are either given or must still be determined. Operational and testing loads of such tanks with plane walls depends upon tank height; and means of making calculations with and without tank reinforcement are included. The diagrams also permit calculation of isotropic plates equipped with fins using a substitute thickness of the plate. Load and force of the plates; bending moment, stress, and deflection of freely pivoting plates; and dimensioning are discussed. Bearing forces in pivoting plates and arrangement of reinforcement are also considered. M.W.R.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-34821 Michigan State Univ., East Lansing.
A SPECIFIC HEAT STUDY OF Cs_2 $MnCl_4 \cdot 2H_2O$ IN A MAGNETIC FIELD
Norman Duane Love (Ph.D. Thesis) 1967 150 p
Available from Univ. Microfilms: HC $7.00/Microfilms $3.00 Order No. 67-14521

Adiabatic calorimeters for studies at He^4 and He^3 temperatures, and the measuring electronics have been described. Specific heat studies of single crystals of $Cs_2MnCl_4 \cdot 2H_2O$ have been made in zero and non-zero magnetic fields. The zero field specific heat study: (1) compares well with the calculated specific heat from the magnetic susceptibility; (2) gives the Néel temperature as 1.84° ± 0.01°K; (3) indicates that 25% of the entropy is recovered above the Néel temperature due to short range ordering, and (4) gives a sublattice magnetization curve as a function of reduced temperature which agrees with the measured magnetization curve from an NMR study and with the curve computed for a f.c.c. lattice using a three dimensional Ising model. Specific heat studies for several external magnetic fields in each of three orientation A, B, and C which are approximately the (0 T T), and (1 T T), and (T T T) directions respectively, have been made. A method for orientating the crystal so that its easy direction of magnetization is parallel with the external magnetic field is described, and a possible method for searching for a spin-flop transition is suggested. Dissert. Abstr.

N68-34843 Oklahoma Univ., Norman.
RADIATIVE HEAT TRANSFER IN AN EMITTING ABSORBING AND SCATTERING BOUNDARY LAYER
Fu Chu Lee (Ph.D. Thesis) 1967 182 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-16733

The basic model utilized is the radiant heat transfer between two diffusely reflecting and emitting plane walls with an isothermal separating medium which scatters, absorbs, and emits thermal energy. The Gaussian quadrature formula is used for integral terms, and the integrodifferential equation of transfer is thus reduced to a system of linear differential equations. As a result, a set of dimensionless parameters which are continuous functions of optical depth and are independent of temperature, may be obtained for isothermal media. Experimental scattering functions for aluminum, iron, carbon, silica and glass were reduced to a discrete form corresponding to Gaussian quadrature coordinates of a third order approximation. Through the comparison of dimensionless parameters, it was concluded that the data computed from isotropic scattering may be utilized for radiant heat transfer prediction for real media. The problem of coupled radiation and convection in boundary layer flow over a flat plate was formulated. The fluid was an emitting, absorbing and scattering medium. The plate was assumed to be nongrey and diffusely reflecting and emitting. Solutions for a non-radiating medium and for a non-scattering medium were also obtained. Dissert. Abstr.

N68-34851 Purdue Univ., Lafayette, Ind.
TRANSFER NUMBER ANALYSIS OF SOLID CARBON COMBUSTION AT HIGH TEMPERATURES
Ismail Mehmet Yeyinmen (Ph.D. Thesis) 1967 113 p refs
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-16724

Calculations of mass transfer in many processes are complicated and time consuming. In order to estimate the mass transfer rate in a simpler manner Transfer Number which is similar to Heat Transfer Coefficient in some respects, has been devised. In the combustion of solid carbon, a complex mass transfer phenomenon takes place simultaneously with heat transfer and chemical reaction. An analytic expression of the combustion rate for carbon has been a subject to several researchers. One of the approaches is the application of transfer number. In this work, the mass transfer rates of carbon by the transfer number approach are calculated in two ways, using the composition of the combustion products and the similarity between mass-heat transfer, for the combustions above 1000°K under fully developed laminar flow. The mass transfer rates of carbon are also determined experimentally under the same conditions. Dissert. Abstr.

N68-34873*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A TECHNIQUE FOR DETERMINING THE SPATIAL DISTRIBUTION OF RELATIVE RADIANT INTENSITY IN SHOCK LAYERS OVER BODIES AT ANGLE OF ATTACK AT HYPERSONIC VELOCITIES
Robert M. Reynolds [1968] 21 p refs Presented at the 3rd AIAA Aerodyn. Testing Conf., San Francisco, 8–10 Apr. 1968
(NASA-TM-X-61224) CFSTI: $3.00 CSCL 20M

Described is a technique for obtaining experimentally, in a ballistic range, a complete mapping of the spatial distribution of the relative intensities of radiating gases over the front surfaces of models at angle of attack. Results are presented for four different models at velocities between 5.5 and 6.8 km/sec and at angles of attack up to 36°. All models were launched into a 50% CO_2 – 50% N_2 gas mixture at ambient pressures between 5 and 60 torr. Author

N68-34875# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THERMODYNAMICS OF NON-STOICHIOMETRIC URANIUM DIOXIDE [THERMODYNAMIQUE DU BIOXYDE D'URANIUM NON-STOECHIOMETRIQUE]
P. O. Perron May 1968 56 p refs
(AECL-3072) CFSTI: HC $3.00/MF $0.65

This is a review of the data on the thermodynamics of oxygen in uranium oxides. The experimental techniques used in obtaining the data are described, and their relative precision is discussed. Each measurement involved the oxygen partial pressure at equilibrium with an oxide of a given oxygen-to-metal ratio. The pressure measurements were relatively accurate, but characterization of the oxide phase was difficult. This could lead to appreciable errors in the data for slightly hyperstoichiometric uranium dioxide. The data were statistically analyzed, and the most probable set of data for hyperstoichiometric uranium dioxide is indicated. Similar calculations for hypostoichiometric dioxide were not possible because of the dearth of data. The data are useful in fuel preparation and can also help to explain second-phase particles in uranium oxides and oxygen redistribution during irradiation of oxide fuels. Author

N68-34886 Texas Univ., Austin.
HEAT AND MASS TRANSFER IN LAMINAR PIPE FLOW WITH THERMODYNAMIC COUPLING EFFECTS
Alvin Michael Bloom (Ph.D. Thesis) 1967 111 p
Available from Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-14804

The process of transferring a foreign coolant through a porous wall into the flow of a hot fluid is generally known as mass transfer cooling. The applications of nonisothermal flow through a porous-wall pipe with mass transfer cooling are found in rocket motors and nuclear reactor cooling systems in which high energy flows exist. The present investigation determines the effects of thermodynamic coupling on the temperature distribution, Nusselt

number, and cooling requirements in a laminar pipe flow with foreign coolant injection. Based on the theory of non-equilibrium thermodynamics the basic equations for a binary mixture of perfect fluids are believed to give an adequate description of the present problem. Thus, the velocity, mass fraction, and temperature distributions can be obtained by a simultaneous solution to the conservation equations of mass, momentum, and energy. The results show that when the thermodynamic coupling effect is neglected, the heat transfer to the wall from the entrance to an arbitrary axial location will be less than when coupling is included. Hence, a non-conservative estimate of the cooling requirements will be obtained when coupling is neglected. Dissert. Abstr.

N68-34946 Columbia Univ., New York.
HEAT TRANSFER IN SIMULATED BOILING
Yonathan Bard (Ph.D. Thesis) 1966 182 p
Available from Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-16024

Until recently, it was generally believed that agitation of the liquid by the bubbles caused the high rates of heat transfer observed in nucleate boiling. Opinions have been divided on whether the growing or rising phases of the bubble cycle were the main contributors to the agitation. Different correlations were derived from the two assumptions. Recently, it has been suggested that the high rates of heat transfer were due to rapid evaporation from a liquid microlayer at the base of the bubble. The difficulty in studying the phenomenon arises from the fact that the relationship between bubble formation and growth on the one side, and heat transfer on the other, is a reciprocal one: each one is promoted by the other. Dissert. Abstr.

N68-35008 Saskatchewan Univ., Saskatoon.
SELF-EXCITED VIBRATING DIFFUSION FLAMES
Ramanujapuram Anandampillai Srinivas (Ph.D. Thesis) 1967 126 p
Available from Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-11414

An experimental investigation into the self-excited vibrations of enclosed laminar diffusion flames under conditions of forced convection has been undertaken. The burner used in these studies consists of concentric fuel and air tubes, the combustion space being formed by that part of the outer tube which is above the plane of the fuel tube tip. It has been found that self-excited vibrations occur only when the natural frequency of the fuel system is low, and this has been obtained by connecting cylindrical resonator directly to one end of the fuel tube. A mechanism of flame vibration has been proposed and its validity tested under a wide variety of experimental conditions. The effect of changes in the volumetric rates of flow or fuel and air on the vibrating flame in different combustion tubes and for different combustion tubes and for different fuel system frequencies has been determined and the results have been correlated on the basis of suitable dimensionless groups. Dissert. Abstr.

N68-35116*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT INVESTIGATION OF THE EFFECTS OF APOLLO HEAT-SHIELD SINGULARITIES ON ABLATOR PERFORMANCE
Thomas E. Walton, Jr., William G. Witte, and Brian J. O'Hare Washington Sep. 1968 62 p refs
(NASA-TN-D-4791) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A flight investigation was conducted to evaluate the performance of the Apollo ablative heat-shield material under perturbed heating conditions caused by several simulated Apollo heat-shield singularities. The recovered spacecraft, which contained simulations of the Apollo singularities, experienced an order-of-magnitude less recession in the unperturbed areas than had been predicted. A recalculation of the surface recession utilizing revised rate-controlled oxidation constants obtained from arc-jet tests produced results compatible with the measured surface recession. With the exception of the upstream lip of both simulated umbilical fairings, no appreciable increase in surface recession attributable to the singularities was noted. The effects of simulated Apollo singularities on ablator performance were minor, as evidenced from the recovered spacecraft. Author

N68-35226 Northwestern Univ., Evanston, Ill.
THE THERMAL CONDUCTIVITY OF BINARY MIXTURES IN THE DENSE GASEOUS STATE
Barry Martin Rosenbaum (Ph.D. Thesis) 1967 387 p
Available from Univ. Microfilms: HC $17.55/Microfilm $4.95 Order No. 67-15327

A horizontal coaxial cylindrical cell was used for the determination of the thermal conductivity of binary mixtures of the carbon dioxide-methane and methane-carbon tetrafluoride systems in the dense gaseous region. Thermal conductivities were established for pure carbon dioxide, pure methane, and pure carbon tetrafluoride at high pressures. The measurements were carried out at temperatures of approximately 60°, 100°, 130°, and 160°C and for pressures ranging from 50 up to 10,000 psia. Argon was used as a calibrating fluid. The thermal conductivity values presented are estimated to be correct to within 2% to 3%. Values of the thermal conductivity at atmospheric pressure, k^*, were established. The residual thermal conductivities, $k-k^*$, for the carbon dioxide-methane system and the corrected residual thermal conductivities, $(k-k^*)/f(T)$, for the methane-carbon tetrafluoride system were normalized with the thermal conductivity parameter. Dissert. Abstr.

N68-35248*# Douglas Aircraft Co., Inc., Santa Monica, Calif.
RADIATIVE AND CONVECTIVE HEATING DURING ATMOSPHERIC ENTRY
W. S. Rigdon, R. B. Dirling, Jr., and M. Thomas Washington NASA Sep. 1968 52 p refs
(Contract NAS1-7757)
(NASA-CR-1170) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The first solutions for radiation-convection coupled stagnation point heat transfer retaining complete spectral detail of the radiative transfer have been generated for a single entry condition both with and without mass injection. The problems associated with obtaining massive blowing solutions with radiation have been generated for a single entry condition both with and without mass injection with radiation have been identified and solution procedures developed. The effect of radiative boundary conditions at the wall has been investigated by obtaining solutions for transparent, black, and totally reflecting walls. The detailed spectral solutions reveal that the originally proposed approximate relation for the divergence of the radiative flux is not suitable for accurate real-gas radiative convective coupling analyses. Therefore, the radiative transfer processes have been investigated and the theoretical basis for a new approximate formulation for the divergence of the radiative flux has been established such as to account for the dominant real-gas radiative transfer effects. Author

N68-35253*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE INFLUENCE OF SEVERAL NEAR-WALL INJECTION CONDITIONS ON THE COMBUSTION PERFORMANCE OF A LIQUID ROCKET ENGINE
Richard M. Clayton 15 Sep. 1968 20 p refs
(Contract NAS7-100)
(NASA-CR-96993; JPL-TR-32-1283) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Efforts to achieve smooth combustion and to establish steady-state behavior of a combustor under a variety of injected flow conditions have been summarized. The experimental combustion

performance of an 18-in.-diam engine was found to vary under different near-wall injection conditions. Because of combustion effects, considerable spray separation is present in a main (core) flow. This separation degrades propellant mixing, especially along the outer periphery of the main flow, and produces as much as 10% performance variation, depending on the operating conditions of an ancillary injection scheme located near the chamber wall. A maximum performance recovery was achieved near the optimum mixture ratio for spray mixing for the boundary injector elements. A rough combustion mode, manifested by high-amplitude disturbances of combustion pressure, was aggravated by poor stability of the streams from the boundary injection system. This condition was alleviated by modifications to the hydraulic design of the boundary system. Author

N68-35266*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CONSERVATION EQUATIONS OF A VISCOUS, HEAT-CONDUCTING FLUID IN CURVILINEAR ORTHOGONAL COORDINATES
L. H. Black 15 Sep. 1968 12 p refs
(Contract NAS7-100)
(NASA-CR-96991; JPL-TR-32-1332) CFSTI: HC $3.00/MF $0.65
CSCL 20M

A complete, written set of the conservation equations of a viscous, heat-conducting fluid is given in curvilinear orthogonal coordinates. Scale factors for a number of coordinate systems are tabulated for convenience in expressing the equations in various coordinates. Author

N68-35284# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MASS EXCHANGE DURING BURNING OF CONDENSED MIXTURES [MASSOOBMEN PRI GORENII KONDENSIROVANNYKH SMESEY]
N. N. Bakhman 19 Sep. 1967 12 p refs Transl. into ENGLISH from Teplo- i Massoobmen V Protsessakh Ispareinya, Akad. Nauk SSSR, Energe. Inst. (Moscow), v. 4, 1966 p 252–258
(FTD-MT-24-210-67; AD-672688)

An evaluation was made of the effect of the solid propellant particle size on the burning velocity. Kinetic and diffusional combustion regimes are considered, and it is shown that when the oxidizer-fuel interface is divided by a thin polymer film, the burning velocity can be either decreased (polyterephthalate or polyfluoroethylene) or increased (polyethylene). These experiments made with plexiglass-KClO4 showed that kinetic factors are also important when the diameter of the gasifying component approaches infinity. The effect of turbulent diffusion of the gasifying component becomes more pronounced as the particle size increases. It is concluded that the dependence of the burning velocity on the particle size is less pronounced with components which are gasified in the pre-reaction zone. When the particle size is sufficiently small, mixing is completed in the pre-reaction zone, and, therefore, the burning velocity becomes independent of the particle size, and the combustion takes place in a purely kinetic regime. TAB

N68-35338# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THERMAL RADIATION PHENOMENA. VOLUME 5. RADIATION HYDRODYNAMICS OF HIGH TEMPERATURE AIR Final Report
Harold L. Brode, Richard W. Hillendahl, and Rolf K. Landshoff Nov. 1967 176 p refs
(Contract DA-49-146-XZ-198)
(LMSC-3-27-67-1, V. 5; DASA-1917-5; AD-672837)

This report introduces the reader to radiation hydrodynamics (RH) and discusses its application to fireballs in the atmosphere. After formulating the basic equations of RH, special attention is given to the radiative transfer problem. Several methods for solving the equations of transfer are touched upon but special emphasis is placed on the two stream method with a frequency averaging procedure, which is specifically designed for use with finite zone sizes. A version of the FIREBALL code which utilizes this approach is described. The physics of fireballs is illustrated with the example of a one kiloton detonation at sea level density and without interference from the ground. Some remarks are made on scaling procedures for extending the result to higher yields and altitudes. Estimates are made of the validity of the models. Author (TAB)

N68-35342# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLUTION ON THE EI-12 OF PROBLEMS OF NONSTATIONARY THERMAL CONDUCTION IN METALS WITH VARIABLE THERMO PHYSICAL CHARACTERISTICS DURING CONVECTION AND RADIANT HEAT EXCHANGE [RESHENIE NA EI-12 ZADACH NESTATSIONARNOI TEPLOPROVODNOSTI V METALLAKH S PEREMENNYMI TEPLOFIZICHESKIMI KHARAKTERISTIKAMI PRI KONVEKTIVNOMI LUCHISTOM TEPLOOBMENE]
L. I. Kudryashev, V. P. Veselov, and A. V. Grekov 3 Jul. 1967 11 p refs Transl. into ENGLISH from Aviats. Inst., Tr. (Moscow), no. 15, 1963 p 295–298
(FTD-MT-66-173; AD-673174)

The article gives the details of solutions using an electronic grid type integrator. The problem is stated in the following manner. The symmetrical problem of heat conduction in a sphere reduces to a system of equations in dimensionless variables. A table shows results of calculation based on use of an EI-12 grid integrator compared to a solution using an IPT-5 machine. The results agree in a satisfactory manner. TAB

N68-35397# RAND Corp., Santa Monica, Calif.
AXIOMATIC THERMODYNAMICS AND EXTENSIVE MEASUREMENT
Fred S. Roberts and R. Duncan Luce Aug. 1968 27 p refs
(P-3907; AD-673150)

The paper applies set theory to various phases of thermodynamics and measurement systems. TAB

N68-35408# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTENSIFICATION OF A PRESSURE WAVE IN A COMBUSTION ZONE [OB USILENII VOLNY DAVLENIYA V ZONE GORENIYA]
S. N. Nikolayev 24 Jan. 1968 9 p refs Transl. into ENGLISH from the publ. "Chuvashskiy Gosudarstvennyy Pedsgogicheskiy Institut. Uchenyye Zapiski" USSR, no. 20, 1964 p 12–17
(FTD-HT-23-34-68; AD-672905)

The purpose of the work is to establish a relation between the parameters of a compression wave passing through the combustion zone and the kinetic characteristics of the chemical reaction. For deriving the analog of the wave equation it is proposed to use the dependence between the density, pressure, and fraction of burned gas instead of the isentropic dependence of density on pressure. For solution of the derived equation the report utilizes the condition of smallness of the pressure variation. However, the produced simplification is insufficiently substantiated; it is not clear why one of the nonlinear terms of the equation is left together with the linear terms. The result of the investigation produced by approximation methods indicates that the compression wave is intensified with its passage through the combustion zone. The effect of various parameters of the reacting mixture on the magnitude of intensification is found in qualitative agreement with experimental data. Author (TAB)

N68-35450# Northwestern Univ., Evanston, Ill. Dept. of Physics.
ON FLUIDS OF PARTICLES WITH SHORT RANGE REPULSION AND WEAK LONG RANGE ATTRACTIVE INTERACTION

John B. Jalickee, Arnold J. F. Siegert, and David J. Vezzetti 23 Jul. 1968 45 p refs
(Contract N00014-67-A-0356)
(TR-II-1; AD-672845)

An appreciably simplified derivation is obtained of the expansion in inverse range of the thermodynamic functions of a system of particles with short range repulsion and weak, long range attractive interaction. We assume all properties of the system with only the short range repulsive interaction to be known and consider this system as a reference system for the purpose of a perturbation expansion. We derive corrections to the van der Waals equation and to the Maxwell construction. The terms in our expansion are integrals over products of the modified Ursell functions of the reference system only and factors which are the transformed long range potential. A simple rule is given to determine the order, in the inverse range of the attractive potential, of each term in the expansion. The simplification of the derivation is achieved by avoiding the expansion and subsequent resummation of any functions pertaining to the reference system. Author (TAB)

N68-35468*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EMPIRICAL STAGNATION-POINT HEAT-TRANSFER RELATION IN SEVERAL GAS MIXTURES AT HIGH ENTHALPY LEVELS
Ernest V. Zoby Washington Oct. 1968 21 p refs
(NASA-TN-D-4799) CFSTI: HC$3.00/MF$0.65 CSCL 20M

A simple empirical method was developed for computing stagnation point heating rates in arbitrary gas mixtures. The method was shown to be in good agreement with stagnation point heating results in air, argon, carbon dioxide, hydrogen, nitrogen, and mixtures of argon, carbon dioxide, and nitrogen for enthalpy potentials up to 50,000 Btu/lbm (1.17×10^5 joule/g). One useful application of the method is for parametric stagnation point-heat transfer studies. The method is in good agrement with the existing prediction methods and is in fair agreement with the existing experimental data. Author

N68-35585# Argonne National Lab., Ill.
TRANSIENT COMBINED CONDUCTION AND RADIATION IN AN ABSORBING NONEMITTING MEDIUM
Roger P. Heinisch, Ralph M. Singer, and Raymond Viskanta (Purdue Univ.) Jan. 1968 40 p refs
(Contract W-31-109-38)
(ANL-7407) CFSTI: HC$3.00/MF$0.65

Transient heat transfer by combined conduction and radiation through a plane layer of an absorbing, but nonscattering and nonemitting, stationary gray medium is considered. The solution of the resultant linear partial differential equation is obtained by an exact analytical solution in the form of an infinite series, the method of lines, and a lumped-parameter finite-difference scheme. These techniques give essentially the same numerical results. This comparison establishes confidence in the latter two methods for possible use in analyzing similar problems in which spectral and/or emission effects are accounted for. The presence of radiation as an added mechanism of energy transfer decreases the length of the transient period; an increase in optical thickness demonstrates the diffusion nature of radiation. For short times after the initiation of the transient, the solution presented is valid for the problem when the medium is a cool gas and the upper boundary is liquid. In particular, for a fluid such as sodium, where temperature profiles in film boiling are desired for short times following vaporization, this analysis can be used as a first approximation. Author (NSA)

N68-35659# Tokyo Univ. (Japan) Inst. of Space and Aeronautical Science.
AN AERODYNAMIC STUDY OF ABLATION NEAR THE REGION OF STAGNATION POINT OF AXIALLY SYMMETRIC BODIES AT HYPERSONIC SPEEDS
Keiichi Karashima, Hirotoshi Kubota, and Kiyoshi Sato Jun. 1968 36 p refs
(ISAS-425, V. 33, No. 7) CFSTI: HC$3.00/MF$0.65

A theoretical approach to aerodynamic mechanism of ablation is made for the region downstream of stagnation point of blunt nosed axially symmetric bodies at hypersonic speeds on the basis of small perturbation approximation. Fundamental equations are derived, under an assumption of sublimating ablation, for a non-reacting laminar boundary layer flow of binary gas mixture, in which transport properties are taken exactly into consideration by use of atomic kinetic theory of gases. It is shown that all physical properties concerning the ablative field can be uniquely determined by matching of an aerodynamic solution with a static one obtained from chemical kinetics. An emphasis is laid on the fact that perturbation field has no longer similar solutions, while basic field has similar ones for given perimetric conditions. Numerical calculation carried out for teflon ablator indicates that local ablation rate decreases gradually with increase of distance from stagnation point and the ratio of local ablation to stagnation ablation rate tends to increase with increase of stagnation temperature in free stream. In order to confirm validity of the present approach, theoretical results are compared with experimental data for teflon. Agreement between theory and experiment is fairly good near the region of stagnation point at free stream stagnation temperature near 1200°C. Author

N68-35662# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
COMPUTER SOLUTIONS FOR THERMAL ACOUSTICAL OSCILLATIONS IN GAS FILLED TUBES
M. T. Norton and R. C. Muhlenhaupt 30 Nov. 1967 88 p refs
(NBS-TN-363) GPO: $0.50

A digital computer program to determine solutions for thermal-acoustical oscillations in gas-filled pipes is described. Using a typical temperature gradient and tube length from test data, the program calculates the effect of changes in heat transfer coefficient, friction factor, and pipe diameter. Details of the program are explained. A comparison is made between computation and one particular test datum point. Although the calculations are based on helium as the media, the program can accommodate any fluid treated as a perfect gas. Author

N68-35692# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE THERMAL DIFFUSIVITY AND THERMAL CONDUCTIVITY OF STOICHIOMETRIC $(U_{0.8}Pu_{0.2})O_2$
R. L. Gibby May 1968 43 p refs
(Contract AT(45-1)-1830)
(BNWL-704) CFSTI: HC$3.00/MF$0.65

Thermal diffusivity of stoichiometric sintered and annealed uranium-plutonium oxides was measured by laser heat-pulse apparatus. Thermal conductivity was calculated from the thermal diffusivity data. Results indicate that the thermal conductivity of the mixed oxide is essentially the same as that of pure UO_2. NSA

N68-35768*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THERMAL CONDUCTIVITY AND THERMAL SHOCK QUALITIES OF ZIRCONIA COATINGS ON THIN GAGE HASTELLOY-X METAL
John D. Buckley [1968] 20 p refs Presented at the Ceram.-Metal Systems Div. Meeting of the Am. Ceram. Soc., Fort Worth, Tex., 8-11 Sep. 1968
(NASA-TM-X-61277) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Two zirconia coatings and a zirconia nickel aluminide cermet coating were flame sprayed and plasma sprayed on thin gage Hastelloy-X metal. Thermal insulation measurements were made on a series of specimens to determine the relationship between

increased coating thickness and thermal insulation capacity of these three coatings. Thermal shock measurements were conducted to observe the effect of coating application and/or thickness on adherence of coatings to the Hastelloy-X metal surfaces. The results showed that composition and mode of application influence thermal shock resistance of sprayed coatings. Insulation capacity of the sprayed coatings proved to be linearly related to coating thickness. Author

N68-35782*# General Applied Science Labs., Inc., Westbury, N. Y.
MIXING AND COMBUSTION IN SUPERSONIC FLOW WITH LATERAL PRESSURE GRADIENT EFFECTS Final Report
Aug. 1968. 111 p refs
(Contract NAS7-590)
(NASA-CR-97068; GASL-TR-636) CFSTI: HC $3.00/MF $0.65
CSCL 21B

An analytical and numerical model was developed for calculating supersonic flows with mixing, finite rate combustion, and lateral pressure gradients; and the formulation provides capability of computing the coupled inviscid-viscous flow field simultaneously without iteration while retaining lateral pressure gradients throughout. Simple transport was used to describe the various diffusional processes, and viscous stress was represented as a linear function of the rate of strain. The coordinate system used required a minimum of physical assumptions. Equations are then simplified for a problem involving a class of supersonic jet flows having a principal flow direction such as found in rocket nozzles and supersonic engine combustion chambers. The analysis and computer program were applied to a variety of unbounded and bounded flows, mixing of dissimilar gases, and analysis of finite rate kinetics. Pure diffusion was accurately predicted by the computer program, which maintained good resolution and did not result in instabilities due to the technique employed. M.W.R.

N68-35806# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
CORROSION AND HYDRIDING OF ZIRCALOY UNDER HEAT TRANSFER CONDITIONS
E. N. Aqua, R. J. Allio, and K. C. Thomas. Aug. 1967. 57 p refs
(Contract AT(30-1)-3269)
(WCAP-3269-56) CFSTI: HC $3.00/MF $0.65

The effect of heat transfer and isothermal conditions on the corrosion and hydriding of Zircaloy-4 tubing has been studied in a pressurized water system. In all of the systems studied, the oxidation was directly proportional to the clad surface (metal-oxide interface) temperature. Nucleate boiling, achieved with a maximum heat flux of 20,000 BTU/ft^2 hr, caused increased oxidation as compared with heat transfer systems using forced convection. The oxidation rate was inversely proportional to the difference between bulk water and clad surface temperatures. The hydrogen absorption was the same in the nucleate boiling systems as in the forced convection heat transfer systems, and homogeneous throughout the tube cross-sections. No abnormal platelet clusters were observed. Author (NSA)

N68-35807# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
THERMODYNAMIC PROPERTIES OF HELIUM 3 HELIUM 4 SOLUTIONS WITH APPLICATIONS TO THE HELIUM 3 HELIUM 4 DILUTION REFRIGERATOR
Ray Radebaugh. 29 Dec. 1967. 145 p refs. Sponsored in part by NSF-NRC
(NBS-TN-362) GPO: $0.70

The thermodynamic properties of liquid He^3-He^4 solutions between 0 and 1.5°K are calculated by using the weakly interacting Fermi-Dirac gas model for He^3 in He^4. Certain experimental data below about 0.4°K are used to evaluate some of the parameters in the model. The properties of both He^3 and He^4 and the total solution are calculated for concentrations of He^3 up to 30 percent. All experimental data agree with the calculated results, although little data exist below 0.4°K. The calculated properties are used to analyze the behavior of the He^3-He^4 dilution refrigerator in both the continuous and single-cycle processes. The maximum heat absorption below about 0.04°K is found to be 82 T^2 joules per mole of He^3 circulated. The effect of an imperfect heat exchanger and He^4 circulation on the refrigeration capacity is discussed. An analysis of two new types of single-cycle processes is also given. Author

N68-35867# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUPERSONIC FLOW OF A COMBUSTIBLE GAS MIXTURE OVER A SPHERE [SVERKHZVUKOVOE OBTEKANIE SFERY GORYUCHEI SMESYU GAZOV]
S. M. Gilinskii, Z. D. Zapryanov, G. G. Chernyi. 18 Aug. 1967. 17 p refs. Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhn. Zhidkosti i Gaza (USSR), no. 5, 1966 p 8-13
(FTD-HT-23-1068-67; AD-673822)

The flow with combustion in the detonation wave around a sphere or a semisphere attached to a cylinder was analyzed for cases where the detonation wave does not disintegrate, or disintegrates in the region with subsonic or supersonic velocity. In the latter case, the analysis did not present any difficulties. In the former case, which resembles the problem of a supersonic jet of finite width impinging on an obstacle, mathematical difficulties were experienced. The analysis was based on the assumption that an axisymmetric body placed in a supersonic stream generates a shock wave which ignites the mixture. The heat release at all points of the detonation wave is equal. First the subsonic and transonic and then the supersonic regions were calculated by methods developed for adiabatic flows. It is concluded that the problem has a unique solution which depends on the selection of the point where the detonation wave disintegrates. For a zero thickness detonation wave this point cannot be determined. At a sufficiently high heat release the detonation wave approaches the Chapman-Jouguet condition. Therefore, in cases when the detonation wave disintegration the point of disintegration will be located at a small distance from the solid surface. Author (TAB)

N68-35899# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorbauelemente.
REPRESENTATION OF HEAT TRANSFER IN CONCENTRIC RING SLOTS BY UTILIZING THE ANALOGY BETWEEN IMPULSE AND HEAT EXCHANGE [DARSTELLUNG DES WAERMEUEBERGANGES IN KONZENTRISCHEN RINGSPALTEN UNTER BENUTZUNG DER ANALOGIE ZWISCHEN IMPULS- UND WAERMEUSTAUSCH]
Heinz Barthels. Dec. 1967. 132 p refs. In GERMAN
(JUL-506-RB)

Experimental and theoretical studies were made to describe the heat transfer in turbulent flow in ring slots by using the analog between impulse and heat exchange for any Reynolds and Prandtl numbers and for all diameter ratios and heating cases. The treatment of this problem requires the knowledge of the flow magnitudes, so that the velocity distribution of the turbulent flow and the site of the velocity maximum in the ring slot were first determined. The calculated resistance coefficients and heat transfer coefficients were compared with the measured values. The experimental results are represented by working formulas which are valid for average and large Prandtl numbers. The Nusselt number depends not only on the diameter ratio but also very strongly on the Reynolds and Prandtl numbers. NSA

N68-35904 National Lending Library for Science and Technology, Boston Spa (England).
ENERGY OF ACTIVATION OF ION FORMATION IN ACETYLENE-AIR FLAMES
V. I. Tverdokhlebov and N. N. Chirkin 12 Aug. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 179, no. 4, 1968 p 921–922 /*tr*s Transl. No. 1145
Available from Natl. Lending Library, Boston Spa, Engl.

The formation of ions in the reaction zone of hydrocarbon flames proceeds by chemi-ionization. The variation of the rate of formation of the ions q with the flame temperature T may be represented in the form of an Arrhenius equation; $q = Ze^{-E_i/RT}$, where E_i is the energy of activation of the ion formation process, Z is a pre-exponential multiplier, R is the universal gas constant. The rate of formation of the ions in the test was determined by the saturation current method. A simple relationship exists between the saturation current I_N and the rate of ion formation; I_N q. From equations (1) and (2) it follows that the expression for the determination of the effective energy of activation is; $E_i = -d \ln I_N / d (1/T)$. Author

N68-35905# California Univ., Livermore. Lawrence Radiation Lab.
TRUMP: A COMPUTER PROGRAM FOR TRANSIENT AND STEADY STATE TEMPERATURE DISTRIBUTIONS IN MULTIDIMENSIONAL SYSTEMS
Arthur L. Edwards 1 May 1968 292 p refs
(Contract W-7405-eng-48)
(UCRL-14754, Rev. 1) CFSTI: HC $3.00/MF $0.65

The TRUMP computer program was developed to solve problems involving transient and steady state temperature distributions in multidimensional systems with arbitrary geometric configurations, initial and boundary conditions, thermal and chemical properties, modes of heat transport and production, and mass flow. Because of the general nature of the partial differential equations and the method of solution, the program may be used to solve a wide variety of boundary value, transport, potential flow, field, and other analogous problems. Thermal problems may include heat transport by conduction, free and forced convection, radiation, and mass flow. Heat may be produced or absorbed by internal heat sources and sinks, phase changes, and chemical reaction. Boundary conditions may include insulation, specified surface temperatures or heat fluxes, or heat transfer by radiation, free convection, or forced convection. TRUMP is written primarily in basic FORTRAN with a FORTRAN-II version for the IBM-7094 computer. A FORTRAN-400 version for the CDC-3600, and LRLTRAN Batch Monitor and OCTOPUS versions for the CDC-6600. NSA

N68-35958# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
THE IGNITION OF URANIUM. PART 1: A LITERATURE SURVEY
R. J. Pearce May 1968 20 p refs
(RD/B/N-1134) CFSTI: HC $3.00/MF $0.65

Available data on the ignition of U in air, O_2, and CO_2 are reviewed. Although many aspects have been investigated, the information is not exhaustive, and a number of gaps in knowledge are obvious. Nevertheless, the major factors that affect ignition in air or O_2 were identified. Information on ignition in CO_2 is much more restricted. A brief survey of the reactivity of uranium hydride is also included. NSA

N68-35971# Aerospace Corp., El Segundo, Calif. Lab. Operations.
APPLICATION OF MATCHED ASYMPTOTIC EXPANSIONS TO RADIATIVE TRANSFER IN AN OPTICALLY THICK GAS Research Report, Jan.–Mar. 1968
George Emanuel Jun. 1968 53 p refs
(Contract F04695-67-C-0158)
(SAMSO-TR-68-267; TR-0158(3240-20)-14; AD-673877)

Radiative transport of thermal energy between concentric spheres is treated by the method of matched asymptotic expansions when the intervening grey gas is optically thick. Adjacent to each wall is a thin thermal layer in which the Rosseland diffusion approximation is invalid. A unique feature of this analysis is the direct application of matched asymptotic expansions to an integral equation. A close connection is thereby established between the structure of the wall layers and the Milne problem of astrophysics. Using the asymptotic approach, uniformly valid results are obtained for the emissive power, temperature slip at the walls, and heat flux. The asymptotic results are compared with the Rosseland approximation and with a numerical solution. A comparison is also made with the plane parallel layer problem to demonstrate the effect of a changed geometry. Author (TAB)

N68-36008 Washington Univ., St. Louis, Mo.
APPROXIMATE SOLUTIONS FOR LAMINAR CONVECTIVE HEAT TRANSFER
Lin Lee (Ph.D. Thesis) 1967 94 p
Available from Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 67-17169

Two approximate methods of solution are used to determine velocity and temperature distribution, and Nusselt numbers in two convective heat transfer problems. Ritz's method is applied to a combined convective heat transfer; Galerkin's method is applied to laminar forced convection in the thermal entrance region. Dissert. Abstr.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-35564*# National Aeronautics and Space Administration, Washington, D. C.
A STUDY OF NASA UNIVERSITY PROGRAMS
1968 85 p refs
(NASA-SP-185) CFSTI: HC $3.00/MF $0.65 CSCL 05I

Selected samplings of NASA-university interactions were made by interviews, university visits, and in-depth studies to assess the overall NASA university program, which has the dual goal of accomplishing the aeronautics and space mission and strengthening the universities involved. Scope of the NASA university program is considered in terms of relations to the total amount of federal university support, university community involvement, and individual programs; and a general summary is included of the research grants and contracts in various areas, flight experiments, and university research centers and laboratories. Sustaining university programs are reviewed, including grants for traineeships, research programs, and facilities; and mention is made of personnel development programs in connection with the overall effort. M.W.R.

N68-35979*# Texas A&M Univ., College Station.
A PROBABILISTIC APPROACH TO THE LONG RANGE PLANNING OF MANPOWER AND OTHER RELATING ELEMENTS
Richard Andrew Lajk (Ph.D. Thesis) May 1967 258 p refs
(Contract NAS9-4317)
(NASA-CR-85119) CFSTI: HC $3.00/MF $0.65 CSCL 05A

Long range planning is considered by a probabilistic model for consolidating project requirements and allocating budgetary limitations. Attention is given to the estimation of total manpower requirements, the development of manpower distribution functions, and the determination of related personnel support requirements. Regression analysis was used to predict total manpower requirements and their allocation over the life cycle of the project; and a constrained-weighted regression technique is presented for a limited data base. A matrix technique is used to determine associated-personnel support requirements and costs for each project; and forecasting the total budgetary limitation for the planning organization via regression or econometric methodology is described. The gap or difference between manpower and budgetary requirements is discussed, and integer programming and response surface technology are used to eliminate this gap. Through this alignment process and the recycling of the rescheduled individual project requirements by a complete data model, a master long-range plan is produced. M.W.R.

N68-36005*# Washington Univ., St. Louis, Mo. Dept. of Economics.

THE IMPACT OF APPLIED RESEARCH AND DEVELOPMENT ON PRODUCTIVITY

Fredric Q. Raines Sep. 1968 55 p refs *Its* Working Paper No. 6814

(Grant NsG-342)

(NASA-CR-96889) CFSTI: HC$3.00/MF$0.65 CSCL 05C

An estimation is presented on the contribution to labor productivity from new technical knowledge, as measured by formal industrial applied research and development (R & D) expenditures. This is done, using a production function framework, separately for a cross section of 24 manufacturing industries accounting for 90% of all government plus privately financed industrial R & D excluding that for atomic energy devices, ordnance, guided missiles, and aircraft. Mathematical models of labor productivity were formulated using 1953 to 1966 data on applied R & D, value added, investment, total manhours, and price deflators from the National Science Foundation and Bureau of Census surveys. Regression analyses were then performed for the same period and variables. Additional assumptions coupled with these regression results were used to construct a matrix of interindustry impacts on labor productivity due to induced technical change. It was concluded that R & D should be included as an input factor in production functions. B.P.

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